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The Practice of Medicine: DR. RUFUS COLE 309

Obituary:
Ernest William Brown: DR. DIRK BROUWER. *Willis Ray Gregg:* DR. W. J. HUMPHREYS. *Recent Deaths and Memorials* 316

Scientific Events:
The Standardization Work on Photography; Awards of the Lalor Foundation; The Beit Memorial Trust for Medical Research; The Industrial Research Institute; Damage Suffered by the Arnold Arboretum from the Hurricane 319

Scientific Notes and News 322

Discussion:
War and Science: DR. F. R. MOULTON. *The Westinghouse Time Capsule:* DAVID S. YOUNGHOLM. *The Salaries of Men of Science Employed in Industry:* PROFESSOR E. L. THORNDIKE 324

Scientific Books:
The Tsetse Flies of East Africa: PROFESSOR CHARLES A. KOFOID. *Television:* DR. S. A. KORFF 328

Reports:
The Research Council on Problems of Alcohol 329

Special Articles:
Influence of Adrenalectomy on Anterior Pituitary Ketogenesis in Rats: DR. I. ARTHUR MIRSKY. *The Chemical Nature and Nomenclature of Choline Derivatives:* DR. ARNOLD DEM. WELCH. *Biological Determination of Vitamin B_1 (Thiamin) in Rhizobium trifolii:* P. M. WEST and PROFESSOR P. W. WILSON 332

Scientific Apparatus and Laboratory Methods:
Apparatus to Assist in Photographing Experimental Material: PROFESSOR L. H. ADDINGTON. *Photoelectric "Colorimeters":* DR. P. E. KLOPSTEG 335

Science News 10

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THE PRACTICE OF MEDICINE[1]

By Dr. RUFUS COLE

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HAVING lived until recently in the shadow of this enormous and beautiful pile of buildings, comprising the New York Hospital and Medical School of Cornell University, I am somewhat embarrassed to stand before this august assemblage of faculty and students and presume to bring you a message. My awe is a little tempered, however, by the recollection of a remark made by the Minister of Health of Egypt, who visited me at the Rockefeller Hospital several years ago. Thinking even one whose life had been spent in proximity to the pyramids might be impressed, I called his attention to your buildings and asked him what he thought of them. "I can tell better after a thousand years," was his cryptic reply. To-day the recollection of his remark makes me conscious of the ephemeral nature of most human undertakings, especially of commencement addresses, and boldens me to speak frankly.

[1] Address delivered at the commencement exercises of Cornell University Medical College, June 15, 1938.

To you, members of the graduating class, I offer my most sincere congratulations, and they are especially warm on this occasion since the degree which you have just received has real significance; it has been obtained only after a long residence in the university, and after you have carried on work as arduous, as intensive and as truly intellectual as that required by any university in the world for the doctor's degree, even for one in philosophy or in pure science.

Until a relatively few years ago the degree of doctor of medicine, even in the best universities of this country, signified something quite different from this. In almost all schools the chief emphasis was laid on vocational training. All of the teachers spent at least a portion of their time in private practice and, in selecting the material which they presented to their students, they chose that which was likely to be of immediate value in professional activities. Gradually, however, the teaching in the courses of the first two

years came into the hands of men whose interests were not entirely related to the utilitarian aspects of their subjects. These men devoted their entire time to teaching and study in their respective fields, and the work of the first two years became of a real academic and university type. In the third and fourth years, however, the character of the work was not changed, the chief emphasis continued to be laid on the vocational aspects, the objectives of the teachers were to train students to make rapid diagnoses, to apply the forms of treatment considered to be most effective, and to provide their students with sufficient actual experience with patients that they might learn to prognosticate correctly the outcome in any individual case. At the completion of the medical course students were given the degree of doctor of medicine, "with all the rights and privileges thereto appertaining," indicating that they were competently trained physicians fully prepared for practice.

The concept of the duty of the university, however, has now shifted. Since, as has been assumed, probably nine out of every ten men receiving the degree of doctor of medicine will spend the greater part of their lives in practice, it is obvious that the great desire of the university is still that society shall be provided with good doctors. This, however, is very different from an obligation to provide the community with trained practitioners. It may even be questioned whether the university is under any obligation to produce trained physicians at all, or is in a position to do so if it would.

During the last half century medicine itself has become a science. I do not intend to-day to discuss the definition of science. During recent years this matter has been sufficiently labored in connection with this very branch of knowledge, and in this debate even I have not been entirely silent. In any case, at the present time, when in the minds of many, even the educated, almost every field of human endeavor has become scientific, the term has lost much of its significance. Farming, hair-dressing, the giving of alms, office management, banking, horse-shoeing, and so on ad infinitum, all have become scientific. In all fields the outward trappings of scientific procedures have been adopted; numerical enumeration of items, at least when there are more than one, and especially when accompanied by graphs and charts, is sufficient to warrant the appellation scientific. It is not necessary, however, to worry about all this pseudo-science which surrounds us on all sides, even in the universities themselves.

I think even the most academically minded now agree that the subject of medicine, of disease, is a sufficiently important subject, and the mass of knowledge concerning it is sufficiently well organized and systematized to justify its designation as a science, and that its devotees, since they are pursuing its study by methods which are employed, and have been successful, in the other fundamental sciences, are worthy to be called scientists. Under these circumstances it seems that medicine is a proper subject to be taken into the university as a discipline worthy to be studied, even if all applications were entirely lacking.

But even if medicine is a science worthy of treatment by scientific methods, the question still remains whether there are any reasons why the future practitioner of medicine should pursue this subject from this point of view. It is theoretically possible that a student might, merely through repeated observation and didactic instruction, become familiar with the characteristic superficial features of disease, that he might learn empirically the various procedures employed in treatment and that he might even, through experience alone, acquire a certain skill in prognosis. Indeed, for many years this was about all that was attempted in the training of physicians. But the university, and even society at large, now demands that physicians shall be familiar with what is known about the nature of the processes constituting disease and of the lesions associated with them. The phenomena of disease are natural processes occurring in conformity with the laws of nature, so far as these are known at present, and these phenomena can only be understood by using the methods universally employed in revealing the mechanisms of other natural events. These are the methods of science.

During the period of your residence the university has placed facilities at your disposal to enable you to become scientists. It assumes that you have made good use of these opportunities. You have acquired much knowledge, but more important, it is hoped that you have obtained mastery of a method. The university, therefore, welcomes you into the society of scholars.

I take it that during your work in the university some of you have become especially interested in the subject-matter and the techniques and methods of one or other of the so-called underlying medical sciences, such as physiology, anatomy or biological chemistry, and have decided to make the study and teaching of one of these branches your life work. The division of science into several disciplines is a purely artificial one and only occurred when the accumulated knowledge became so great that no individual could be a master of the entire domain. The aspiration of Francis Bacon was found to be one impossible of fulfilment. On the other hand, the most productive scientists have been those who have not surrounded themselves by a closed wall, but have provided numerous apertures through which they could pass, to roam in

surrounding fields at will. Anatomists now study function, and physiologists, structure. Chemists bring their technique to the solution of important immunological problems, and even professors of medicine attempt to solve questions concerning disease by the employment of the methods of physics. For the advancement of knowledge the important matter is the formulation of problems. In the attempt to solve them each worker must use the tools to which his hand is fitted. Most of you have undoubtedly read the life of Madame Curie and have been inspired by learning how, through the exercise of her indomitable will, she overcame obstacles and accomplished her purpose. Don't worry too much about the nature of the path, whether it be rough or smooth; keep your eye on the goal. What you have learned of the science of medicine will make you better able to teach, inspire and lead those who will practice, no matter which field of biological science you now or later decide to cultivate.

Some of you undoubtedly hope to give your entire time to the study of the science of medicine itself and to become university professors of medicine or to spend your lives in attempting to solve the riddles of disease. For you the training in the underlying sciences has been indispensable. You can not study alterations in form or function without clear ideas concerning that which is changed.

Most of you, however, will engage in the practice of medicine, and to you I would speak especially. The university believes that it has made it possible for you to become good doctors of medicine. But are you now trained physicians ready for practice? That is another matter.

The statement made by Professor George William Palmer in the life of his wife, Alice Freeman Palmer, deserves repetition. In recounting her interest in domestic affairs, in spite of her preoccupation with intellectual matters, he says, "When at one time she was struggling with a new cook on the subject of bad bread, and after encountering the usual excuses of oven, flour and yeast, had invaded the kitchen and herself produced an excellent loaf, astonished Bridget summed up the situation in an epigram which deserves to be recorded; 'That's what education means—to be able to do what you've never done before.'" But does that suffice when dealing with such a complicated subject as disease, with its protean manifestations and with the life of human beings at stake? If the experimental loaf of bread turns out sour or heavy you can throw it out and begin again.

You may have knowledge of the structure and functions of the human organism in health, even knowledge of a kind which Huxley describes as "the sort of practical, familiar, finger-end knowledge which a watchmaker has of a watch, and which you expect that craftsman, as an honest man, to have when you entrust a watch that goes badly to him," a knowledge to be had only by long concentration of your minds for long periods of time "upon all the complexities of organ and function, until each of the greater truths of anatomy and physiology has become an organic part of your minds—until you would know them if you were roused and questioned in the middle of the night, as a man knows the geography of his native place and the daily life of his home." Moreover, you may also know about disease so that you may be able to picture in your mind at a moment's notice the characteristic lesions of all known diseases, and may be able to pass a perfect examination on all that is known of the functional disturbances following all types of injurious agents, and be able to describe minutely the lesions produced by them. In spite of all this, in my opinion, you would not necessarily be a good physician. Though the physician speak with the tongues of professors and savants, and have not experience and technique, he is become as sounding brass or a tinkling cymbal. It is absurd to assume that you are able to employ surgical methods successfully or to employ the various techniques now used by physicians in treatment. Even to make diagnoses with the rapidity which is necessary in actual practice requires the use of tricks (in the best sense), particular modes of thought and action, with which you are not familiar. In other words, there is such a thing as the technique of practice and those who deny it have never had the experience of being put to the test. This technique you have not learned and can not learn in the true university medical school. Indeed, that school best deserves this title that bothers itself least with attempting to do what is impossible. Moreover, no one, except the self-deluded men who examine you for license to practice, expects you on graduation to be proficient practitioners. This does not mean, however, that you are not well prepared to master the techniques necessary to make you good physicians.

It is not easy to differentiate sharply between the study of the science of disease and the practice of medicine. It is largely a difference of point of view, of emphasis. One may say, however, that the student of the science of disease investigates disease as it affects mankind. The practitioner is primarily interested in the diseased individual. The former may be interested in features of disease which at the present state of knowledge may seem to have little or no significance. The physician, for practical reasons, must concentrate his attention on those features whose importance has been demonstrated. It is not merely a matter of conservation of time, though this is important. The university student may spend days in the investigation of a single case. The practitioner must inves-

tigate, judge and act quickly. Otherwise he starves to death or most of his patients receive no attention whatever. The university lays stress on complete understanding, practice lays stress on skill. It is not a question of treatment. The movement at the end of the last century took care of that. The patient no longer employs a physician merely to have him administer remedies. He comes to the doctor when he is suffering from disease, he wants to be restored to ease or to be relieved of his ails when he has an ailment. But what the patient rightly demands, first of all, on the part of the physician is understanding. Not merely understanding of the physical disharmonies which constitute disease in the abstract, but understanding of his entire constitution as an individual. Both the university student and the practitioner are interested in treatment, but the practitioner is especially concerned with the techniques employed in actual application in the individual case. Whatever the differences, however, the university student and the practitioner must both employ the methods of science. They must both have the scientific habit of mind, and this is especially what the university should give. Both must have curiosity, the desire to learn; both must have honesty, and both must be critical. Unverified opinion can have no place as guides to action. To the practitioner every individual case presents a problem. He must observe, reflect, form an hypothesis and proceed to verify it. The analogy with music is not unilluminating. The study of the theory of music, its history, its relation to psychology are true university subjects. Training of students to be proficient performers on a musical instrument is not a legitimate function of the university, though it is true that some so-called universities so consider it.

Now if you have not yet acquired the necessary technique and skill for practice, where and how are you going to get it? There is no open sesame. It can only be acquired by practice itself and by hard unremitting labor. That does not mean that you can not be aided by observing the methods of master workers, but you can never acquire it through the best correspondence schools of our most famous universities. In earlier years the rudiments of the technique of practice were obtained by following a preceptor, and, so far as it went, this was not a bad way, though it had manifest disadvantages.

To-day the preceptor system has been replaced by the hospital internship. According to the *Journal of the American Medical Association* there are to-day 712 approved hospitals with positions for over seven thousand interns. In addition, there are three thousand positions open for residents in special hospitals. The total number of graduates from approved medical schools last year was 5,377. It is evident that every graduate in medicine has the opportunity to spend one or more years (in a considerable number of instances with pay) in obtaining experience in practice as hospital interns, and almost all graduates now make use of this opportunity. In my opinion there are manifest defects in the intern system as it exists at present. Indeed, I feel that it is the weakest link in present-day medical education. The analogy of the apprentice and the intern has been taken too literally. In most cases all the hospital does is to offer opportunities to the intern. The preceptor cared whether the student did or did not learn, the hospital usually does not care. But hospital physicians can be interested in the training of interns, to their own as well as the student's great advantage. Hospital authorities can undertake more seriously their educational responsibilities.

What can the hospital do? In the first place, it can realize that its group of interns is composed of highly educated, cultivated, serious men whose highest ambition is to serve ably the patients who are under their care, and whose greatest desire is, through practice, to become not only technically skilful, but also more gentle, more humane, more wise. The hospital can provide facilities so that interns may live like cultivated men and students, not like traveling salesmen, and this does not mean luxurious lounges, more bathrooms, better plumbing and luxurious food—not provision for higher standards of living, but for higher standards of work and study. This was clearly recognized by John Billings, a man whose wisdom and greatness we are only gradually coming to recognize, the man who was responsible in large measure for the success and enormous influence of three great institutions, the Johns Hopkins Hospital, the unsurpassed Army Medical Library in Washington and the New York Public Library. When he planned the Johns Hopkins Hospital the residents' quarters were placed in the best part of the main building, large, light, airy rooms with commodious book shelves, and, most important of all, they were in proximity to the library. He realized that the library should be a good one, freely accessible, so that interns not only may read there but that they may take books to their rooms, as many as they like. Hospital libraries should not be mausoleums or storage warehouses. In recent years when visiting hospitals I have made a point of seeing the interns' rooms. What do you think I usually found, even in some of the best and most modern hospitals? Small, dark rooms, containing a bed, a chair or two, a small desk, apparently little used, possibly a few photographs of members of the family or of those who at some future time might become members of the family, and a few books—a very few, and these mostly text-books,

remnants of the student life. I didn't feel so disappointed not to find some evidences of interest in literature or music or pictures, though I am not one of those who believe that culture in the best sense is of no importance in the life of a doctor, but I was surprised to find no evidence of any interests at all, not even an interest in science. To find that a young man could not only go through college but have acquired a university degree and have no interests outside of his daily job did surprise me. While the hospital can not create these interests, it can at least assume that the intern has them. The hospital should not treat interns as employees, make them punch a time clock (of course figuratively) and provide to the minutest detail the kind and amount of work they shall perform. Interns must have freedom. This I realize in large hospitals is difficult, but it is not impossible.

In discussing the responsibilities and opportunities of the visiting physicians, I can only look back on my own hospital days and recall my experiences under Dr. Osler. I feel that he was an ideal chief. Personally interested in every intern under him, considerate of their sensibilities as he was of their time, he seized on every least evidence of curiosity on the part of an intern, stimulated his interest and aided him with advice and help. As those of you know who have read his great biography, his contacts with his interns were not entirely confined within the hospital wards. He never missed a meeting of the various hospital medical societies. I once remember when he was hurrying off after dinner to one of these meetings, an attractive young assistant was drumming on the piano. "Jim, aren't you going to the meeting?" "No, I don't get much out of these meetings." "Do you think I do?" was the reply, and he slammed the door and ran down the steps. But above all he influenced his interns by his example. He taught them how to become good doctors by being one himself. He was interested in his interns, and this every hospital physician can be.

It has sometimes been felt that practitioners no longer have opportunities to help and guide young men and that, as a result, the day of great clinical teachers is past and that society thereby suffers. As a matter of fact, all practitioners connected with the large hospitals now come daily into contact with a group of highly educated young men who are, or should be, familiar with the fundamental nature of disease. By spending a limited amount of time with them, by guiding them, working with them, these practitioners may be of very great educational service. The opportunities for their own development are also there, the greatest teachers have always said that they received more from their pupils than they gave. Moreover, these opportunities are no longer confined to the large centers. With the development of hospitals in the smaller cities, frequently as well equipped as those in great centers of population, the practitioner in a small place now has the same opportunity to become a great teacher as had Daniel Drake in the little Transylvania University beyond the mountains. A group of skilful and devoted physicians in a country hospital who give themselves to the inspiration and training of their interns can to-day cause a path to be beaten to their hospital doors by the best educated young men in the science of medicine that have ever been produced. Young men have a way of being drawn to those who have something to give.

But after all, whether interns shall become good doctors or not depends upon the interns themselves. To make use of the knowledge you have obtained in the university and to retain your scientific spirit now become your chief concerns. In order to obtain complete understanding of your patients it would be necessary to study everything connected with them. Of course, that is impossible and much must be omitted. The matter of picking and choosing your procedures becomes of great importance, and the facility of doing this wisely is one of the qualities that determine the good physician. Our hospitals are now great organizations in which there are arrangements for making all kinds of technical investigations. The intern becomes a part of this organization, and he is able to use any one of a dozen different laboratories to aid in his study. This is all very useful, but it carries with it obvious dangers. The student begins to deal with formulae, with words, instead of with the things themselves. In the middle ages medicine was in the hands of physicians, surgeons and barbers, and, as Garrison says, "the barber was in some respects the most worthy of the three, since he was driven to study nature at first hand." One of the chief disadvantages of the present arrangement is that when the intern becomes an independent practitioner, as most of you will and must, this convenient arrangement for calling on others will no longer be available to you. Aid you must and will have, but it must be more carefully chosen. At the present time a large part of the work of the contributing services in the hospital is probably unnecessary. It results from the fear of omitting something. Seeking for completeness is mistaken for striving for perfection, which is the aim of the artist in every field. The best painters have not been those who have attempted to depict each individual hair. It is this fear of omission that impels taking the most minute and extensive histories, and the recording of routine elaborate physical examinations, all of which occupy so much of the intern's time and leave so little opportunity for thinking and for independent action. It is unnecessary for me to attempt to mention the numerous laboratory procedures that have been introduced in recent

years and have come to be employed in a routine, instead of a discriminating, manner. All this is not science. Darwin didn't make and record all his numerous observations for the sake of completeness. He early formulated an hypothesis, which he was attempting to verify. The intern should be given opportunity to employ the methods of science in solving his problems, not to become mere clerks and technicians. That not all interns take advantage of opportunities when they have them is obvious. How many interns keep their own records of cases, classify them, brood over them, and try to formulate their own pictures and concepts, and try to rationalize the methods of treatment they employ? Records of cases carefully abstracted, compared and digested are of infinitely greater educational value than random experiences, however exciting and interesting. To pass through your intern years in a fever of agitation, interested only in obtaining a rapid series of impressions, will add little to your real experience or improve your training for practice. Stimulated to collect and record and abstract all the cases of pneumonia occurring in the hospital during my own intern years, this practice gave me an interest in this disease which has never left me and has proved to be a source of great and rewarding satisfaction. It has been said that if a student learn syphilis he knows medicine. This can be said of any disease. An interest in any condition will lead a student into paths covering the whole range of pathology.

The life of an intern to-day is difficult. His duties are many and arduous. But the difficulties are not so great that they can not be surmounted. When I see the long lists of interns and residents in good hospitals, and contrast this with the handful of workers forty years ago, I can not believe that, in spite of the great increase in the methods employed, the intern's life need be more strenuous to-day. The master-word in the hospital, as in the university, is still *Work*. I once had a temperamental resident from one of the Balkan states who told me that he was ready to die for science. My reply to him was that it is much more important to work for it.

Hospital days are and should be laborious days, but they also may be days of the greatest joy and pleasure. For the first time you will come into a position of real responsibility for the lives of your patients. If it is the right kind of a hospital you will enter intimately into the lives of fellow human beings and see them stripped as bare of all pretense, of all artificialities, of all their former surroundings as they are of their clothes. It is a cold and unimpressionable individual who is not strongly moved by this close contact with those who are in distress, who are laying bare their deepest secrets and thoughts, who frequently are seeing death eye to eye. Your relation to your patients may resemble that of the family doctor. The close companionship with your associates, who are undergoing the same experiences, makes for sympathetic fellowship and stimulates close and enduring friendships. The companionships of school days, the attractions of college and club life can never make the same impression as do the hospital intern days.

During your intern days the hospital should be your home, your workshop and your playground. You should need nothing more. Learn to shun outside affairs that will complicate your life and disturb concentration on your work, rejoice if you are too poor to own an automobile to carry you from the straight road, avoid the movies, you will find sufficient tragedy as well as comedy close at hand, above all, avoid like a plague entangling affairs of the heart. This latter advice in these days, I fear, is like locking the stable door after the horse is stolen, since hospitals are now hard put to it to find interns that are not already married. But after forty years of hospital experience I am still convinced of the soundness of Dr. Osler's advice to "put your affections in cold storage during your intern years." The joys of family and domestic life will be all the greater because waited for and worked for.

And after the hospital will come practice. As you know, this word is employed in two ways, first, as the musician practices to acquire proficiency, and second, as the doctor or lawyer practices to pursue his profession. When we speak of practicing medicine let us not forget the implication of the word, through practice we become proficient. Bear in mind that education does not end with the intern years, it should extend throughout your entire professional life. Power grows as experience extends. The difficulties of maintaining a scientific attitude will be enormously increased once you have left the protecting walls of the hospital, no matter how insecure that protection has been. Amid the distractions of domestic life, the competition and rivalry in professional work, hurt by the apathy of the public for intrinsic merit,—whether you will be able to continue to exercise the scholarly and scientific point of view will depend largely on the use you have made of your hospital years. The best guard against retrogression is a constant desire to learn more about the real nature of disease, and particularly about some particular disease. In other words, have a problem. Of course, with all the distractions of practice, the methods you use will have to be comparatively simple ones. But if you are supplied with understanding and insight, microscopes of low power are sometimes able to reveal important truths. Some of the most important medical discoveries have been made by men in active practice. Time extends for those who have a driving passion to learn. The

example of Dr. Meltzer should impress all of you. For many years he drove about New York every day with a horse and buggy seeing patients; then, tying his horse to a hitching post, he spent all the time he could spare in a laboratory. During this period he made most important contributions to medicine and physiology. Later, after the Rockefeller Institute was established, he went there to work, and died one of the most productive students of disease that our country has had.

To maintain the scientific habit of mind it is not essential that a physician work in a laboratory, but, if he has curiosity, it is almost certain that he will be drawn there at least occasionally. Thirty years and more ago the physician who kept a microscope under a bell jar in his consulting room was spoken of with derision. How much more serious to-day that so many young doctors with wonderful scientific training, even if they have a microscope, never look through it from one year's end to another. Many, possibly most, men now in practice have no laboratories of their own, and many never enter a laboratory after their student days. All of them, however, hire technicians or send specimens to some commercial laboratory for the most complicated tests. Most of them are of the routine variety, done by technicians who have no conception of the meaning or purpose of what they are doing. Doctors have their patients pay large sums for blood examinations or for "having blood chemistry done" (whatever that may mean, and the doctors themselves frequently do not know) or for routine x-ray examinations that may be useless so far as the patient is concerned, and are of no real interest to the doctor. All this is not science. Let us take care that in the process of attempting to make medicine more scientific, physicians themselves do not become less scientific.

In spite of all that I have said, there is no question but that the practice of medicine to-day is far better than it was forty years ago. But one sometimes wonders whether, considering all the great additions that have been made to our knowledge of disease, and in view of all the time and money and thought that have gone into medical education, the doctors of to-day are really as able as we like to think. When one considers how slowly and ineffectively and incompletely therapeutic measures which have well-established value have been applied, such as those which are useful in syphilis, diabetes, pernicious anemia and pneumonia, to mention only a few, one wonders. That it has been necessary for governmental agencies to engage in active campaigns to promote the proper and extensive use of these and other therapeutic measures is a sad commentary on our profession.

Certain critics blame the defects entirely on the present method of university education. They say that it is suitable only for the few gifted students and not for those who are to compose the rank and file of the profession. Some would have training for practice carried through the entire four years of the medical course. Others believe that during the study of the underlying sciences more stress should be laid on practical applications. It seems to me that these ideas arise from mistaken notions, sometimes even by the universities themselves, as to what the university is attempting to accomplish, and above all from an entire disregard of the educational importance of the hospital and of practice itself. It is obvious that men undertaking the work leading to a doctor's degree should have the proper background and training and have the mental qualifications required for true university work. They should have that desire to learn, that devotion to learning, that inflexible will that is necessary if one is to lead the true intellectual life. They must be interested in the subject itself, and disinterested in the material rewards, social opportunities and stimulating emotional experiences associated with the practice of medicine. They must regard the practice of medicine as an intellectual and humane undertaking, a vocation, not merely an occupation, a learned profession, not a skilled craft.

Do the university schools of medicine treat the students as independent, thoughtful workers, stimulated by an insatiable curiosity and moved by an inordinate desire to learn, and have the various departments been organized with an eye to providing students with opportunities to effect this will and satisfy this desire? If the will is not fixed and the desires undeveloped, is the main effort, by example rather than by precept, to stimulate the development of these qualities and inspire these enthusiasms? These, to my mind, should be the important endeavors, rather than to urge the students to acquire all available information. The employment of laboratory methods alone will not accomplish these ends. To carry out required laboratory routine procedures may enable students to learn and understand more easily and may make information more real, but unless the work is conducted by the students in an independent manner and they be given opportunity to learn for themselves, the students will acquire nothing more than bare facts, facts which some of them at least could have obtained more rapidly and easily from books. While certain students may be more readily stimulated to work and study in their earlier years if the relation of the underlying sciences to disease is indicated to them, it seems to me unimportant whether the professors in these sciences are familiar with medicine or not, that is, whether they possess degrees in medicine. The great school of physiology that developed under the influence of Michael Foster was in Cambridge, far removed from departments of medi-

cine. And it has exerted an enormous influence, not only on the increase of knowledge concerning disease but on the practice of medicine and on practitioners as well. Let students obtain a real interest in physiology and, if they have intelligence, the bearing of physiological facts will be obvious to them when they study about disease.

That medical students at present acquire an enormous fund of information is certain. In interviewing students fresh from the schools I frequently stand amazed by the fluency and skill with which they discuss the most complicated subjects of physiology and pathology and the very latest discoveries in medicine and related sciences, at times even before the ink is dry on the reports. One sometimes wonders, however, if range of information is necessarily identical with depth of knowledge, or whether the facts have been digested and transmuted into wisdom. That medical students possess so much information is not surprising. For four years each of the various professors, and there are very many of them, have attempted to compel the students to learn everything that is known about his particular subject up to the moment of going to press. It is not necessary to recapitulate the large number of special divisions into which medicine has been divided; the students are expected to take at least a few meals in each one of them. There is so much hospitality that the meals all turn out to be banquets. Is it any wonder that most of the students have indigestion, mental as well as gastric? In recent years many attempts have been made to correct this situation, and they are undoubtedly in part successful, but I am sure many deans still have very bad hours worrying for fear their students will not have mastered every subject in the field of medicine. So far as I can see there is only one remedy. Let it be required that every professor, every teacher, each year pass an examination not only in his own subject but one in every other subject in the curriculum. Let the professor of biological chemistry keep familiar with the latest methods in obstetrics, the professor of ophthalmology be informed of progress in physical chemistry and endocrinology, the professor of bacteriology keep abreast of improvements in x-ray therapy. It is frequently held that at least once in their lives all medical students should have heard about all that is known in the whole field. A doctor should never be ignorant of any fact relating to medicine! But is this necessarily education on the university plan? Is this cramming with facts scientific education or does it produce scientists?

Over thirty-five years ago, long before the first university department of medicine was established, the following words were uttered by a man who was primarily a practitioner and clinical teacher: "All that the college can do is to teach the student principles, based on facts in science, and give him good methods of work. These simply start him in the right direction, they do not make him a good practitioner—that is his own affair. To master the art requires sustained effort, like the bird's flight, which depends on the incessant action of the wings, but this sustained effort is so hard that many give up the struggle in despair. And yet it is only by persistent intelligent study of disease upon a methodical plan of examination that a man gradually learns to correlate his daily lessons with the facts of his previous experience and with that of his fellows and so acquires clinical wisdom."

Let the university heed that it turns out men who have the scientific habit of thought, not merely men who are stuffed with facts. Let us, however, not ask too much of the university. If the prevailing standards of practice do not fulfil our expectations, let us not blame this all on the university, but let us keep in mind the parts which the hospital, the visiting physicians and even the interns and practitioners themselves should play in the training of good physicians.

If to-day I have attempted a "counsel of perfection" it has not been uttered in any spirit of arrogance or criticism. We are still far from the perfect state. The future rests with you who are beginning your careers. You are fortunate in the choice of your time. May you continue to be scientifically and critically minded. May you continue to be students as long as you live.

OBITUARY

ERNEST WILLIAM BROWN

In any account of Brown's life his work on the problem of the motion of the moon must necessarily occupy the central place. At any time during a period of fifty years he was working on some phase of this subject. His lunar theory has justly been called definitive. The creation of this theory and the construction of his "Tables of the Motion of the Moon" are among the greatest accomplishments in the history of gravitational astronomy.

In the summer of 1888, then a student at Cambridge, England, he began the study of Hill's papers on the lunar theory at George H. Darwin's recommendation. In a series of publications beginning in 1891 he presented theoretical developments inspired by Hill's work, and their numerical application, *i.e.*, the coefficients of certain classes of inequalities in the motion of the moon. For six years he continued his preparatory studies. His mastery of the whole field is apparent in his "An Introductory Treatise on the Lunar

Theory," published in 1896. Intended to be an introductory text-book, it is elementary in many parts, but it also deals with the advanced phases of the subject.

The systematic development of the theory began in 1894, and in 1908 the fifth and last part of the theory appeared. In an address in 1914 he said: "My own theory, which was completed a few years ago, is rather a fulfillment to the utmost of the ideas of others than a new mode of finding the moon's motion. Its object was severely practical—to find in the most accurate way and by the shortest path the complete effect of the law of gravitation applied to the moon. It is a development of Hill's classic memoir of 1877."

This statement is typical of the modesty which he always showed in referring to his own contributions. It does not emphasize his own resourcefulness in finding that "shortest path." His development of the theory was by no means a slavish following of a standard pattern. He did not hesitate to change from one form of the equations to another if he saw a good reason for doing so, and he introduced minor and major changes of procedure whenever this would shorten the work. This freedom in handling problems in dynamics was a characteristic feature of his work throughout his life. He had no patience with theorists who apply "hit-or-miss methods," as he used to say.

The most original part of the lunar theory is the last part, in which the effects upon the moon's motion due to the attractions of the planets and the deviation from sphericity of the earth and the moon were obtained. There is perhaps no other field in celestial mechanics where a more careful treatment is necessary in order to avoid pitfalls. Probably no mathematical astronomer has ever shown greater ability than Brown in dealing with such a problem.

The accuracy of the solution of the "main problem" is of a totally different order than that of solutions that preceded it. In Hansen's theory some coefficients are in error by some tenths of a second of arc. Delaunay's theory is seriously hampered by slow convergence, some of the more difficult terms being in error by a whole second of arc. Brown's solution gave the coefficients to one one-thousandth of a second of arc, and very few coefficients greater than that value were not obtained. That this accuracy was actually reached was confirmed by the preliminary results obtained in a numerical verification of this part of the lunar theory. This work was carried out by his pupil, Dr. W. J. Eckert, in close cooperation with Brown during the past few years.

Immediately after the theory had been completed he began preparations for the construction of the tables. His approach to this work is again an example of thoroughness. Hansen was a past master in the art of tabulation, but Brown found it possible to introduce a number of important improvements. The most ingenious original feature is the arrangement of the single-entry tables, in which form the largest terms in the moon's motion are tabulated. The perfection of the tables was to a large extent due to the efficient assistance by Dr. H. B. Hedrick, who was employed as chief computer during nine years. In later years he spoke frequently with admiration of Hedrick's work.

While the construction of the tables was in progress a comparison with observations was made in order to ensure that the best possible constants were used in the final tabulations. A proof of the accuracy of this discussion, and of the lunar theory, was obtained some years ago when Spencer Jones completed a revision of Newcomb's occultation work. From totally different material he derived results that were in excellent agreement with those obtained by Brown.

After the tables were completed his most notable contribution connected with the motion of the moon was the well-known publication in 1926: "The Evidence for Changes in the Rate of Rotation of the Earth. . . ." A comparison of the differences between observation and theory in the longitudes of the moon and the sun was used to advance the explanation that both are due to changes in the rate of rotation of the earth.

The progress toward the present status of our knowledge about the earth's rate of rotation was not made in one step by a single investigator. It is generally agreed, however, that Brown's contributions were the most important and the most consequential ones. His definitive evaluation of the planetary perturbations marked the end of a long period of doubt whether the observed motion of the moon could be accounted for by gravitational theory alone. His contribution of 1926 marked the beginning of an era in which the rotation of the earth is definitely known to be affected by irregular variations. This problem had his most vivid interest ever after. His occultation campaign and his discussions of lunar observations during the last twelve years of his life were part of his study of the rate of rotation of the earth.

Until 1910, when the lunar theory was finished and the work on the tables was well in hand, Brown devoted but a small portion of his energy to original studies of subjects not intimately related with the lunar problem. From then on his activity covered a wider field. With the exception of occasional studies on a variety of topics his central subject was the study of gravitational problems presented by the solar system by quantitative methods. In appraising the value of these investigations it should be kept in mind that he was seeking new methods and that he was always attracted by

the most difficult problems. His first theoretical papers on the Trojan Group were later followed by a general theory, applicable to all planets of this group, and especially to the more difficult ones having a large amplitude of libration. The study of the motion of the eighth satellite of Jupiter is an example of his preference for difficult problems.

Gradually Brown became actively interested in the more general problems present in the development of theories of planetary motion. His contributions to the theory of resonance were part of these investigations. He also laid the foundation for the construction of the "Tables for the Development of the Disturbing Function" (1933). Most of his contributions in this field were collected in a coherent presentation in the treatise "Planetary Theory" (1933), written in collaboration with Professor C. A. Shook.

During the last three years of his life the "main problem" of the lunar theory had his attention again. This led to several separate investigations of considerable importance. The most noteworthy of these is the treatment of the stellar problem of three bodies. His analysis of this problem showed again his ability to adapt available methods to the treatment of the special problem before him.

At the very early age of thirty-one he was elected fellow of the Royal Society of England. This was the beginning of a long sequence of honors that continued throughout his life.

In 1891 Brown came to the United States to become instructor of mathematics in Haverford College. Two years later he was promoted to the rank of professor. He remained at Haverford until 1907, when he became professor of mathematics in Yale University. He served Yale until his retirement in 1932. The appointment at Yale came when the lunar theory was nearly completed, and the construction of the tables loomed as the next phase of the work. Arrangements were then made by which Yale University undertook the cost of their calculation, printing and publication.

In earlier years Brown taught various subjects in pure and applied mathematics; in later years his only courses were elementary and advanced dynamics and celestial mechanics. Many of his students kept in touch with him in later years, and some became lifelong friends.

His relations with Yale Observatory, which were entirely unofficial with the exception of a period during which he was acting director, were mutually beneficial.

He was an active member of the American Mathematical Society, was editor of the *Transactions* and of the *Bulletin* for a number of years and president for two years, 1914–16. Of the American Astronomical Society he was president for three years, 1928–31. Since 1911 he was associate editor of the *Astronomical Journal*.

He was born in Hull, England, on November 29, 1866, and died in New Haven, Connecticut, on July 22, 1938. He was unmarried.

DIRK BROUWER
YALE UNIVERSITY OBSERVATORY

WILLIS RAY GREGG

DR. WILLIS RAY GREGG, late chief of the U. S. Weather Bureau, died in the Blackstone Hotel, Chicago, on Wednesday evening, September 14, 1938, where he had been attending an aviation conference between the Civil Aeronautics Authority and the Air Transport Association of America and where he was stricken with coronary thrombosis on the afternoon of Wednesday, September 7. Dr. Gregg, a descendant of James Gregg, who went from Ayrshire, Scotland, to Ireland in 1690, and thence to America in 1718, was born on January 4, 1880, at Phoenix, N. Y., where he grew up on a farm.

His formal education, attested by a B.A. degree in 1903, was obtained at Cornell University. An honorary Sc.D. was awarded to him in 1937 by Norwich University. On March 1, 1904, he entered the Weather Bureau as an assistant observer at Grand Rapids, Michigan. After a service of nearly three years, first at this station and later at Cheyenne, Wyoming, he was transferred to the Bureau's research observatory at Mount Weather, Va., on the crest of the Blue Ridge, 45 miles from Washington. Here for seven years he made important studies of the upper air—a line of investigation with kites and balloons that then was rapidly developing in many countries owing largely to the aid the knowledge thus obtained of winds and weather was to the whole art and practice of aviation. In November, 1914, he was called to Washington as assistant chief of the section of aerology, a section that soon became a division. In 1917 he was made chief of this important division, in which capacity his counsel and active aid frequently were requested by other agencies of the government and by civilian organizations, and always freely given whatever the sacrifice of time and effort on his part.

This wide experience, together with his profound sense of justice, untiring industry, even temper and cheerful optimism, well fitted him for the important position of chief of the Weather Bureau, to which he was appointed on January 31, 1934. This was a high honor, richly deserved, but it carried with it responsibilities, burdens and worries—worries about meeting rapidly increasing demands with a nearly stationary personnel.

Owing to his pleasing personality, ability and willingness Dr. Gregg's services were sought for in many

lines. He was active as a Mason and was a past master of his lodge; in his church he sang in the choir and was a vestryman; in science he was a member of the National Advisory Committee for Aeronautics (chairman of the executive committee and of the subcommittee on meteorological problems), International Meteorological Organization, International Meteorological Committee, the Guggenheim Committee on Aeronautical Meteorology and of several other organizations and committees of like nature, including the Royal Meteorological Society and the American Meteorological Society (treasurer, 1923–1935, president, 1938). He also was a member of the Washington Philosophical Society (treasurer, 1921), Washington Academy of Sciences, American Geophysical Union (chairman of the section on meteorology, 1932–1935) and fellow of the American Association for the Advancement of Science. He was a member and frequenter of the Cosmos Club, in which he had many close friends.

In addition to technical articles, he wrote also the monograph, "Aerological Survey of the United States," 1922 and 1926, and "Aeronautical Meteorology," 1925, second edition, 1930.

On October 15, 1914, he married Mary Chamberlayne Wall, daughter of an Episcopal minister of Berryville, Va. He is survived by his wife, one daughter, Ruth Marguerite, a brother and three sisters.

W. J. HUMPHREYS

RECENT DEATHS AND MEMORIALS

ARTHUR HERMAN ADAMS, a consulting engineer of New York City, died on September 25 at the age of fifty-nine years.

THE REV. WALTER G. SUMMERS, head of the department of psychology at Fordham University, died on September 24 at the age of forty-nine years.

DR. ARTHUR STANLEY MACKENZIE, from 1911 to 1931 president of Dalhousie University, died on October 2 at the age of seventy-three years. From 1891 to 1905 Dr. Mackenzie was professor of physics at Bryn Mawr College and was later for a short time head of the department of physics at Stevens Institute of Technology.

DR. A. ROSENTHAL, a neurologist of Jerusalem, was killed on September 14 when passing through Ramleh, where vehicles were being stoned.

DR. VOLKMAR KOHLSCHÜTTER, since 1909 professor of inorganic and physical chemistry at the University of Bern, died on September 10 at the age of sixty-five years.

Nature reports that the Dutch Medical Association, the Leyden Faculty of Medicine and the Society of the History of Natural Sciences of Leyden organized a celebration beginning on September 23 to commemorate the two hundredth anniversary of the death of Herman Boerhaave. Visits were paid to the old St. Cecilia Hospital, where Boerhaave gave clinical lectures, his country house "Poelgeest" near Leyden and the village of Hardewyk on the Zuyder Zee, the seat of the university where Boerhaave presented his inaugural thesis on July 15, 1693. It is planned to publish a commemoration volume.

SCIENTIFIC EVENTS

THE STANDARDIZATION WORK IN PHOTOGRAPHY

FOLLOWING a request from the International Standards Association that the United States take leadership in standardization work in the field of photography, the Standards Council of the American Standards Association meeting in New York approved the undertaking. A new committee will be organized representing manufacturers, distributors and users of photographic materials in the United States. Its duties will be: (1) To initiate an American Standards Association project on standardization in the field of photography under the leadership of the Optical Society of America; (2) to take leadership in the international project on photography as well as cooperating in the work.

The work to be undertaken will include formulation of definitions, dimensional standards and recommended practices in the field of photography; and the establishment of methods for testing, rating and classifying the performance characteristics of materials and devices used in photography, including its industrial applications, but excluding cinematography.

Part of the work of the committee will consist in collecting and codifying what has already been done in the above fields. For instance, efforts have already been made to set up logical and systematic nomenclature in small sections of the photographic field. Considerable progress has also been made by manufacturers of sensitive materials and photographic equipment in establishing definite dimensional standards for materials and appliances. The role of the new committee in these cases will be to bring such manufacturers together and obtain agreement so that greater interchangeability may be achieved.

A detailed outline of photographic problems for the new committee's consideration was read and approved. While some of these are probably not at the present

moment ready for attention, others have already been the object of considerable study and may be standardized rather easily and promptly. Many items not at present included may be added later on.

Work, as at present planned, will affect amateur, portrait, commercial and news photography, as well as process work, aerial photography, radiographic and photomicrographic photography, documentary, medical and photomechanical photography. It will also include work in the graphic arts and in wired and wireless transmission of pictures.

The field of photography is so broad and diverse that the matter of personnel for the new committee assumes unusual importance. Forty organizations are to be invited to appoint representatives. Eleven of these, including Federal Government departments, are user groups, twelve might be classified as general interests, sixteen are manufacturers of photographic materials, and one a distributor organization. The wide scope of the work will undoubtedly require that subcommittees be appointed to make recommendations as to the desirability and feasibility of standardization within specific and limited fields.

AWARDS OF THE LALOR FOUNDATION

THE Lalor Foundation announces its third series of fellowship awards which authorizes grants to the amount of $25,000 for the academic year 1939–40. The amount of each award will be determined on the basis of the previous training, demonstrated competence and promise of the candidate as respects his chosen field of work. Except under unusual circumstances, the amount of the individual award will range between $1,800 and $2,500.

Seven fellowships of the 1938–39 series are being currently administered by the foundation, which was organized in 1935. The activities of the holders of present fellowship awards are in the fields of biochemistry, cryogenics, the chemistry of enzymes, photochemistry and macro-molecular chemistry, and the institutions at which the researches are being conducted are the University of Upsala, the University of Leipzig, Harvard University, the Johns Hopkins University, the Massachusetts Institute of Technology, the University of Chicago and the University of California.

The awards in the 1939–40 series will be given for fundamental research work in any of the various fields of chemistry. Support for industrial research or research in applied science is not intended. The awards are open to both men and women and can be used for work anywhere in the United States or abroad. Men and women in academic service who may be on sabbatical leave or other leave of absence are among those eligible for appointment. Attainment of the degree of Ph.D. or training equivalent thereto is a requirement for candidacy. There are no other limitations either as respects age or residence.

In approving the enlarged budget to cover this series of prospective awards, the board of trustees of the foundation has had in mind a somewhat more definite allocation than in the past of a portion of the funds available.

The official announcement points out that there is a growing appreciation of the intimate interrelationship that exists between chemistry and the modern science of medicine. In this country, there are only a few men who, by having both a thorough background in fundamental chemical research and a commensurately adequate experience in the biological and medical sciences, are qualified to accomplish the most important work in these fields and for whom the attainment of outstanding eminence is to be expected. Therefore, as respects a reasonable proportion of the Lalor awards to be granted, preference will be accorded to candidates shaping their careers or carrying on research to accomplish a more effective application of the principles and discoveries of physical and organic chemistry upon problems of biochemistry, chemotherapy and pharmacology. In the case of awards of such character, renewals of the grants for an additional year or longer will be favorably considered. Time to be spent in acquiring training in the medical studies necessary for a thorough understanding of the clinical aspects of these subjects will be considered acceptable as a part of the plan of work of the candidate.

The qualifications of candidates will be passed upon by a Selection Committee consisting of Drs. C. A. Kraus, of Brown University; Arthur B. Lamb, of Harvard University; Roger Adams, of the University of Illinois; Hans T. Clarke, of Columbia University, and the secretary of the foundation.

Inquiries and requests for application forms for awards should be addressed to C. Lalor Burdick, Secretary, Lalor Foundation, Wilmington, Delaware. Applications are to be in the hands of the secretary by December 15, and appointments will be announced early in March, 1939.

THE BEIT MEMORIAL TRUST FOR MEDICAL RESEARCH

A MEETING of the trustees of the Beit Memorial Fellowships for Medical Research was held recently for the election of fellows and other business.

As reported in *The British Medical Journal* the total number of fellowships held by full-time workers during the year 1937–38 was twenty-three. The number of candidates at the present election was higher than usual. Five applied from Canada and three from

Australia. Reserve funds made it possible to award more junior fellowships than are ordinarily given each year, and the election of twelve new junior fellows brought the total number of those elected since the beginning of the trust in 1910 to exactly 200. A fresh edition has been printed this year of the Green Book, which summarizes briefly the after-careers of each fellow and their present position in research.

The following elections were made:

Senior Fellowship (value £700 a year).—David Ezra Green, to continue his research on the rôle of vitamin B_1 in the oxidation of pyruvic acid, and to study a new flavin-protein compound in milk (Institute of Biochemistry, University of Cambridge).

Fourth-Year Fellowship (value £500 a year).—Myer Head Salaman, to continue his research on vaccinia and animal pox viruses (Lister Institute of Preventive Medicine, London).

Junior Fellowships (normal value £400 a year).—Geoffrey Bourne, biochemist, Commonwealth Advisory Council on Nutrition, Sydney, N.S.W., 1937, the significance of vitamin C in the endocrine system (department of human anatomy, University of Oxford); Andrew Lawrence Chute, experimental studies in metabolism of the brain (department of physiology, University College, London); Robert Oswald Lennard Curry, the physiology of speech disorders by photographic study of laryngeal movements (University College, London); James Frederick Danielli, the permeability of normal and denervated muscle to metabolic products and to drugs (Institute of Biochemistry, University of Cambridge); John George Dewan, "insulin shock" treatment of schizophrenia by experimental studies of brain metabolism (Institute of Biochemistry, University of Cambridge); Catherine Olding Hebb, the effect of thoracic sympathectomy on the activities of the lung (department of physiology, University of Edinburgh); Bernhard Katz, electric excitation and transmission of impulses in nerve and muscle of animals (department of biophysics, University College, London); Jonas Henrik Kellgren, painful conditions of the limbs and back (department of clinical research, University College Hospital, London); John James Duncan King, dental caries and parodontal disease (Medical School, University of Sheffield); Hermann Lehmann, blood sugar in animals and iron metabolism in plants (Institute of Biochemistry. University of Cambridge); Walter John O'Connor, effect of strophanthin on the oxygen consumption of the heart (laboratory of pharmacology, University of Cambridge); Harold Scarborough, mode of destruction of vitamin C in the human body (clinical and chemical laboratories, Royal Infirmary, Edinburgh).

THE INDUSTRIAL RESEARCH INSTITUTE

CURRENT industrial research problems and progress being made in the laboratories in behalf of business were reviewed at the fall meeting of the Industrial Research Institute on September 23 and 24 at Rye, N. Y.

Maurice Holland is acting executive of the institute, which is an affiliate of the National Research Council. The membership is made up of research executives of American industries, who are attempting to put American industrial research on a more efficient business basis through surveys and other cooperative effort.

The program included reports on the progress of surveys now being conducted by the institute on the construction and control of research budgets, problems of personnel, organization and committee recommendations. Robert B. Colgate, of New York, vice-president in charge of research for the Colgate-Palmolive-Peet Company and chairman of the executive board of the institute, presided.

The institute was organized last May after a factual survey among leading scientific research men prominent in their respective fields of industry demonstrated both the need and the desire for a cooperative agency where common problems of laboratory organization, administration and direction could be discussed and attacked. Its headquarters are at the offices of the Division of Engineering and Industrial Research of the National Research Council at 29 West 39th Street, New York.

The executive committee of the institute held a discussion of future plans as well as reviews, preliminary reports and recommendations. The members of the executive committee are: H. W. Graham, general metallurgist, Jones and Laughlin Steel Corporation, Pittsburgh, who is *vice-chairman;* O. A. Pickett, research director, Hercules Powder Company, Wilmington, Del.; Donald Bradner, director of research and development, Champion Paper and Fibre Company, Hamilton, Ohio; H. Earl Hoover, vice-president, The Hoover Company, Chicago; J. M. Wells, vice-president, American Optical Company, Southbridge, Mass., and G. E. Hopkins, technical director, Bigelow-Sanford Carpet Company, Thompsonville, Conn.

DAMAGE SUFFERED BY THE ARNOLD ARBORETUM FROM THE HURRICANE

DR. ELMER D. MERRILL, professor of botany and administrator of the botanical collection of Harvard University and supervisor of the Arnold Arboretum, writes that in the late afternoon and early evening of September 21 the Boston area experienced its worst wind storm since weather records have been maintained. This was the West Indian hurricane that proceeded northward along the New England coast. The rainfall was relatively slight in Boston, but the wind velocities at times reached approximately (87 miles actually reported) 90 miles per hour. Dr. Merrill states that a velocity of 187 miles an hour was recorded at Blue Hill Observatory—10 miles southeast of the Arboretum—and that the velocity was certainly over 100 miles an hour at the Arboretum. He states that

during twenty-two years spent in the Philippines, a region noted for its numerous destructive typhoons, he actually experienced higher wind velocities only two or three times. Naturally large property damage resulted, and literally hundreds of thousands of trees were uprooted or so badly damaged that they will have to be removed and replaced. The Arboretum suffered severely. The loss of species, however, was almost negligible, as younger plants survived. The following gives an account of the damage suffered:

The storm was intense at 5:00 P. M. and gradually increased in violence. The worst damage was done in the arboretum between about 5:30 P. M. and 6:30 P. M. A tour of the grounds at 5:30 P. M. revealed relatively slight damage; for example there were only three or four trees in the extensive pine grove back of the administration building that were down or showed signs of weakening at that time; an hour later nearly all the trees in the entire planting were prostrate. The sound of rustling leaves, breaking branches, and creaking trunks was at times almost deafening. The worst of the storm was over by 8:00 P. M.

A hurried survey made early the next morning showed that approximately 1,500 trees were either uprooted, broken off, or their tops so badly damaged that they will have to be removed. Many others were injured, but can be saved by judicious pruning. The losses include some of the oldest and largest trees in the arboretum, as well as some of the rarest ones. Some of the roads were impassable, and all paths and roads were strewn with debris, broken branches, and fallen trunks. Damage was particularly serious in certain exposed areas, notably on the slopes back of the administration building, on the southeast or exposed side of hemlock hill, where scores of century old native hemlocks fell, in the southern part of the pinetum, where many of the largest pines, firs, and spruces are prostrate, and along the southeast side of the Peters hill area, particularly in the collections of poplars and oaks.

SCIENTIFIC NOTES AND NEWS

THE American Society of Mechanical Engineers announces the election to the presidency of the society on September 27 of Professor Alexander G. Christie, of the Johns Hopkins University. He will assume office on December 9.

DR. WILLIAM S. MIDDLETON, dean of the Medical School of the University of Wisconsin, has received the award of the council of the Wisconsin State Medical Society. The inscription on the award reads in part: "A son of Pennsylvania, twenty-six years an educator of physicians and now dean of the University of Wisconsin Medical School, distinguished consultant and clinician, deviser of the council on scientific work of the State Medical Society of Wisconsin, for your accomplishments and lofty inspiration in the teaching of students and practitioners, for your quarter of a century of public service, and for your outstanding influence in the development of a high quality of medical service for the citizenry of Wisconsin."

ACCORDING to *Nature*, Dr. Hermann Fink, professor of the biochemistry and technology of fermentation in the University of Basle, has been awarded the Scheele Medal of the Stockholm Chemical Society.

H. W. DICKINSON, of London, a founder and past president of the Newcomen Society of England and for thirty years one of the heads of the Science Museum at South Kensington, was the guest of honor at a reception held at the New York Museum of Science and Industry on September 28. The gathering followed an informal dinner tendered Mr. Dickinson by the American branch of the Newcomen Society. The speakers included Dr. Frank B. Jewett, president of the museum; Charles Penrose, senior vice-president of the American branch of the Newcomen Society, and Mr. Dickinson.

DR. REINHOLD RUEDENBERG, consulting engineer of the General Electric Company, Inc., in London, has been appointed Gordon-McKay professor of electrical engineering at Harvard University, and Dr. John Everett Gordon, of Chicago, field director of the International Health Division of the Rockefeller Foundation, has been appointed professor of preventive medicine and epidemiology in the Medical School.

DR. VIKTOR FRANCIS HESS, formerly professor of experimental physics at the University of Innsbruck, who in 1936 shared a Nobel Prize for his work on cosmic rays with Dr. Carl David Anderson, of the California Institute of Technology, has joined the faculty of Fordham University.

AT Radcliffe College, Harvard University, Dr. William F. Ross, research associate of organic chemistry at the Massachusetts Institute of Technology, has been appointed resident director of the laboratories of chemistry, and Dr. M. Gene Black has been appointed director of the department of health education.

IN the College of Medicine of the University of Vermont, Dr. Harold B. Pierce has been appointed head of the department of biochemistry and acting head of the department of pharmacology, and Dr. John E. Davis has been appointed instructor in pharmacology and biochemistry.

PROFESSOR FRED E. FOSS, head of the department of civil engineering at Cooper Union, New York City,

retired at his own request at the end of the last academic year. Ray C. Brumfield, assistant professor of civil engineering, has been appointed acting head of the department for 1938–39.

DR. NEIL E. RIGLER, of the North Carolina Agricultural Experiment Station, has been appointed plant physiologist in the division of plant pathology and physiology of the Texas Agricultural Experiment Station, College Station.

DR. E. C. OGDEN, of the Gray Herbarium of Harvard University, has been appointed instructor in botany at the University of Maine.

AT the University of Cambridge, Dr. A. J. Bradley has been appointed assistant director of research in crystallography, and Dr. J. E. Driver has been appointed university demonstrator in the department of chemistry.

THE board of directors of the Herty Foundation has appointed Frank Heyward, Jr., state forester, field director, and Dr. Charles H. Carpenter, technical director, to carry on the work in pulp wood development of the late Dr. Charles H. Herty at Savannah. Mr. Heyward has leave of absence from the State Forestry Department to accept the acting field directorship of the foundation. Dr. Carpenter, chief chemist of the Herty Foundation Laboratory, has served as executive director since Dr. Herty's death.

WILLIAM HUDSON BEHNEY, assistant professor of zoology at the University of Vermont, has been given leave of absence to become director of the State Fish and Game Service, where he succeeds Dr. Russell P. Hunter, who resigned recently in order to accept a similar position in Connecticut.

AT the Field Museum of Natural History, Dr. Francis Drouet has been appointed a member of the department of botany. He will have charge of the collections of cryptogamic plants. Bryan Patterson, assistant curator of paleontology, has returned to the museum after spending several months in Europe, making studies of fossil mammal collections in the Museum national d'Histoire naturelle in Paris and in the British Museum (Natural History) in London. Dr. Julian A. Steyermark, assistant curator of the herbarium, has returned from a collecting trip, during which a botanical survey was made of the flora of the St. Francis River in Wayne County, Missouri. Dr. C. E. Hellmayr, associate curator of birds, who for some years has been in Vienna, where he has been working on the preparation of the "Catalogue of Birds of the Americas," is now in London, where he moved on account of political conditions in central Europe.

DR. GEORGE E. BARKER has been appointed incumbent of the industrial fellowship established at the Mellon Institute by the Elgin National Watch Company, Elgin, Ill. The research program will cover broadly the chemical aspects of technical problems in the watch industry. One of the first subjects of investigation will be watch lubrication.

DR. ERMA A. SMITH, associate professor of physiology in the Iowa State College, has been allotted a grant by the Committee on Research of the American Medical Association to be used in a study of the effects of carbon monoxide gas on gastro-intestinal motility.

ELLSWORTH MCSWEENEY has become a research associate at Battelle Memorial Institute, Columbus, and is beginning a study of organic tin compounds, one of several fundamental research projects financed by the institute.

PROFESSOR E. LOEWENSTEIN, formerly of Vienna, known for his investigations on the immunology and bacteriology of tuberculosis, has taken up work at the University of California.

DR. ALFRED C. REED, professor of tropical medicine in the University of California, is at present in Europe. He planned to visit a number of hospitals in London and to go to Beirut, Damascus, Jerusalem, Cairo, Rhodes, Athens, Italy, France, Stockholm, Copenhagen and Holland. He is president-elect of the American Society of Tropical Medicine, which will meet in Oklahoma City from November 14 to 17.

DR. WALTER CARTER, of the Pineapple Experiment Station, Honolulu, returned recently after an eleven-month tour of the pineapple areas in Africa, Malaya, Dutch East Indies, Philippine Islands, Australia and Fiji.

A. H. G. ALSTON, an assistant keeper in the department of botany of the British Museum (Natural History), plans to visit Trinidad and then to travel across Venezuela and Colombia to Buenaventura, collecting plants for the museum and studying the ferns of northern South America. He expects to be away for about seven months. On his way he will attend the first South American Botanical Assembly, which will be held at Rio de Janeiro from October 12 to 19.

IN connection with the recent allotment of funds to the Geological Survey by the Public Works Administration for a study of strategic metals, D. F. Hewett spent the latter part of August in examining tin prospects and possibilities in the vicinity of Tinton and Keystone, S. Dak.

PROFESSOR JULES DRACH, of the University of Paris, in attendance as the representative of the Paris Academy of Sciences at the fifth Congress of Applied Mechanics recently held at the Massachusetts Institute

of Technology, delivered a course of four lectures from September 22 to 26 on "The Logical Integration of Differential Equations, with Applications to the Equations of Geometry and of Mechanics," at the Rice Institute.

LECTURES will be given at the University of Buffalo under the Foster Fund by Professor E. M. K. Geiling, of the University of Chicago, at the end of October on "Recent Trends in Endocrinology" and on "Some Biological Adaptations of the Whale," and during the week of November 7 by Professor M. S. Kharasch, also of the University of Chicago, on the general subject, "Chain Reactions Involving Atoms and Free Radicals in Solution." The Foster Fund was given to the university by Mrs. Orin D. Foster, in memory of her husband, to endow a lectureship in chemistry and related fields. Mr. and Mrs. Foster also gave the university Foster Hall, which houses the department of chemistry and the School of Pharmacy.

SIR WILLIAM BRAGG, president of the Royal Society, opened the Sir Robert Hadfield Metallurgical Laboratories of the department of applied science of the University of Sheffield on September 14. The new extensions and improvements, which were built at a cost of £30,000, represent the first stage in a plan of development for which an appeal for £250,000 was made two years ago. Sir Robert Hadfield, chairman and managing director of Hadfield's, Limited, Sheffield, gave £10,000 of the £30,000 required and equipped one of the research laboratories at a cost of £2,000. He also gave £5,000 for the plans for the new foundation.

THE Academy of Medicine of Washington, D. C., held its first autumn meeting on September 28. Dr. Philip Manson-Bahr, clinical director of the London School of Tropical Medicine, gave an address on "The Life and Works of Patrick Manson, Father of Tropical Medicine." Dr. Manson-Bahr is the author of a life of Sir Patrick Manson. The academy met this fall without one of its members, lost in the Hawaiian Clipper tragedy of July the twenty-ninth. Dr. Earl Baldwin McKinley was the moving spirit in the founding of the academy. Dr. Harry H. Donnally addressed the academy in tribute to Dr. McKinley.

THE Cotton States Branch of the American Association of Economic Entomologists will hold its 1939 annual meeting on February 21, 22 and 23, 1939, at Tampa, Fla. The Hillsboro Hotel has been selected as headquarters, where special rates of from $2.50 up have been obtained for delegates. Due to the overcrowded condition of Florida cities during the tourist season, reservations should be placed early by those who expect to attend.

A MISSOURI Minerals Industry Conference, sponsored by the Missouri School of Mines and Metallurgy and the Missouri Geological Survey, will be held at the School of Mines on October 21 and 22. The object of the conference, according to Dr. William R. Chedsey, director of the School of Mines, is for the mutual benefit of the producers of mineral products and the service institutions that are supported by the states. It will take the form of the presentation of problems of the various mineral industries by mineral producers. Dr. H. A. Buehler, of the Missouri Geological Survey; S. M. Shelton, supervising engineer of the Mississippi Valley Experiment Station of the U. S. Bureau of Mines, and Dr. Chedsey will outline the services that are now available to the producers of minerals in Missouri.

THE Society for the Promotion of Engineering Education will hold its annual convention in 1940 at the University of California in Berkeley.

FELLOWSHIPS in the Medical Sciences, administered by the Medical Fellowship Board of the National Research Council, of which Dr. Francis G. Blake, of Yale University, is chairman, will be available for the year beginning July 1, 1939. These fellowships are open to citizens of the United States and Canada who possess an M.D. or a Ph.D. degree. They are intended for recent graduates and not for persons already professionally established. Fellows will be appointed at a meeting of the board about March 1. Applications to receive consideration at this meeting must be filed on or before January 1. Appointments may begin on any date determined by the board. For further particulars address the Secretary of the Medical Fellowship Board, National Research Council, 2101 Constitution Avenue, Washington, D. C.

DISCUSSION

WAR AND SCIENCE

FOR a number of months European civilization has been making history around sharp curves at high and rapidly increasing speed. With brakes ineffective and accelerators pushed down to the floor, on September 14 it appeared to be crashing through the guards and about to plunge into the abyss of another world war. Then something happened, something unparalleled in the history of the world. It began to respond to control and changed its course to a smoother and safer road.

There were undoubtedly many factors that restrained Herr Hitler from precipitating Europe into war. In spite of his 10,000 airplanes and Germany's capacity

for producing more, he may have feared the ultimate strangling effects of his opponents' control of the sea. Perhaps he remembered that Italy had an army in Ethiopia and another in Spain and a long coast that it could not easily defend. Perhaps the announced intention of France and Russia and Great Britain to defend Czechoslovakia against aggression sounded in his ears like the rumble of a distant storm. He may have had a normal human reaction from the frenzy of his radio address to Germany. In spite of his harsh and uncompromising words, he may have heard an inner voice that warned him against arbitrarily condemning millions of young men to death. The dramatic visits and appeals of Mr. Chamberlain may have pleased his vanity and softened his heart. The intercessions of the President of the United States may have inclined him to a magnanimous gesture appropriate to a conqueror. All these things and many more may have had their effects.

The supreme influence, however, was the radio address of an elderly gentleman to his countrymen and to the remainder of civilized mankind. In it there was no boasting of irresistible might and preparations for war; no attacks on enemies, real or manufactured for the occasion; no claims of great achievements or promises of them in the future. In simplicity and humility Mr. Chamberlain explained what had happened and the steps that he had taken in his attempts to avoid open conflicts. He described the sacrifices Czechoslovakia had agreed to suffer in the interests of peace. He frankly expressed his fears of the horrors of war. With infinite restraint and consideration for the opinions of others, he made his nearest approach to being critical in his simple statement that he thought a certain position of Herr Hitler was unreasonable. After the seven minutes of Mr. Chamberlain's address, ranting and screaming and defying their enemies will no longer seem appropriate for statesmen in Great Britain or in Europe or in America.

There have been many turning points in history, most of them marked by great battles. One was when the Greek phalanxes at Marathon piereed the ranks of the Persian hordes and threw them into confusion. One was when Charles Martel and his army turned back the Saracens at Tours. One was when the allied forces shattered the power of Napoleon at Waterloo. And probably a more important turning point in human history than any of these was the radio address of Mr. Chamberlain, which was, of course, only the climax of a series of dramatic events. Like a mysterious voice coming through the ether from another world, it plead for tolerance, cooperation and the rule of reason. It aroused the better nature of mankind. Mothers in England and France and Germany and Italy and Czechoslovakia were happier that night than they had been for months. A cloud was being raised, a new light was shining, and peace in Europe was in the making.

An essential difference between the recent dramatic events in Europe and previous turning points in history is that in this crisis the opinions of the masses were an important influence. This was certainly true in democratic England. It was true even in Germany. The cheers of the Germans for Mr. Chamberlain, a potential enemy but on a peace mission, can not have escaped Herr Hitler. The visits of Mr. Chamberlain and his broadcasts, which were carried throughout Germany, had more profound effects than the winning or the losing of a battle. For many years, during which international relations will probably be established on a new basis, the words of Mr. Chamberlain and his visits to Germany and the final compromise of the interested parties will be cherished memories.

These dramatic and gloriously hopeful pages of human history could not have been written without the miraculous means of transportation and communication provided by science. Too often science has been charged with being largely responsible for the evils of mankind and with adding greatly to the horrors of war. In his presidential address before the British Association for the Advancement of Science, Lord Rayleigh refuted those charges. Perhaps a better refutation would be a proof that wars have not become more terrible with the advance of science. No one who has read of the siege of Jerusalem or of the Crusades or of the Thirty Years War in Germany would maintain such a position. All wars have caused deaths and disease and unhealed wounds and starvation and endless suffering. Science has saved more human life in the past ten years than was destroyed during the world war. Science can easily establish the fact that the sum total of its effects has been to relieve suffering and save life. And just now its applications have been an essential factor in initiating a new period in human history.

It would be naïve to assume that the agreements reached at Munich were not based in part on national jockeying for position. It would be even more naïve to believe that human hearts have suddenly become generous and altruistic. No such miracle has happened or will happen for a geologic age. It is true that Czechoslovakia is being dismembered and Russia is ignored. Already dictators are strutting as the saviors of peace. But the masses feel that they have been consulted, that town meetings have been held on a national scale. For at least a generation it will not be easy for Europe to become involved in a general war without the approval of the humble citizens who would suffer because of it. The pattern of negotiation and compromise has been set, and the power of a moral principle is again stirring mankind.

What has all this to do with scientists? Only to re-

mind them that they face an opportunity. For years they have cultivated cordial international relationships among themselves. As I have already written elsewhere, science is wholly independent of national boundaries and races and creeds. This is no idle statement. It is a living reality, illustrated in the international congresses of scientists that are being held in large numbers. Last December the American Association for the Advancement of Science passed a resolution calling on the British Association for the Advancement of Science and "all other scientific organizations throughout the world to cooperate not only in advancing the interests of science but also in promoting peace among nations and intellectual freedom in order that science may continue to advance and to spread more abundantly its benefits to all mankind."

At its recent meeting the British Association passed resolutions for closer cooperation with the American Association and organized a division for exploring the interrelations of science and society. The American Association will not neglect its opportunities to make science and the generous ideals of science more important factors in the progress of society. Its age and honorable history, its broad interests, which include not only the natural sciences but the humanities, its large and rapidly increasing membership, its obligations to society and its unparalleled opportunity to be of service to mankind all inspire its membership.

F. R. MOULTON
OFFICE OF THE PERMANENT SECRETARY
OF THE AMERICAN ASSOCIATION FOR
THE ADVANCEMENT OF SCIENCE

THE WESTINGHOUSE TIME CAPSULE

So many readers of SCIENCE and others have shown interest in the questions propounded in my letter published August 19 that a brief explanation of how these problems were finally settled may be in order. I wrote that Westinghouse was desirous of depositing a "Time Capsule" on the site of the New York World's Fair, containing a "cross section of our time" for posterity 5,000 years from now.

The problem contains three major parts: (1) how to build a vessel capable of lasting 5,000 years, (2) how to leave word of its whereabouts for historians of the future and (3) the selection and preservation of the contents. There are many subsidiary problems, such as protection of the deposit against vandalism. Burial 50 feet deep in the swampy soil of the fair site is expected to take care of this latter problem quite effectively.

The construction of the vessel was undertaken by a committee headed by M. W. Smith, Westinghouse manager of engineering. It was decided that a hard alloy of copper would be most suitable. For reasons of strength and convenience, a torpedo shape was chosen. The Time Capsule, as finally constructed, is seven and a half feet long and eight and three eighths inches in diameter. The outer shell consists of seven cast segments of Cupaloy (copper 99.4 per cent., chromium .5 per cent., silver .1 per cent.) which is temperable to the hardness of mild steel, but has corrosion resistance and electrical characteristics similar to those of pure copper. The segments are screwed together hard and sealed with asphalt; the nearly invisible joints peened out and the outer surface burnished.

The inner crypt, six and a half inches in diameter and six feet nine inches long, is lined with an envelope of Pyrex glass, set in a water-repellent petroleum base wax. This crypt, evacuated, washed and filled with slightly humid nitrogen, contains the "cross-section of our time."

After consultation with librarians, museum authorities and the U. S. Bureau of Standards, it was decided to leave word for the future by means of a book, printed on permanent paper in special inks. In order that the appearance of this "Book of Record of the Time Capsule" might match its permanence, Frederic W. Goudy consented to design it and set a portion of the type. A special run of 100-pound book paper was made to Bureau of Standards specifications. Suggestions for binding and general treatment were obtained from the National Archives, the New York Public Library and other sources. The cover is royal blue buckram stamped in genuine gold. The signatures are sewed by hand with linen thread.

Copies of this book will be sent to selected libraries, museums and other repositories throughout the world, in the hope that a few will survive in some form for the required time. The book contains a message asking that it be preserved and translated into new languages as they appear; a description of the Capsule's contents, and the exact latitude and longitude of the deposit as determined by the U. S. Coast and Geodetic Survey to the third decimal point in seconds. The geodetic coordinates are tied into the survey's national network, on which astronomical as well as geodetic data are given. In addition, instructions are included for making and using instruments to locate the Time Capsule by the methods of electromagnetic prospecting.

That our tongue may be preserved, the book contains an ingenious "Key to the English Language," devised by Dr. John P. Harrington, of the Smithsonian Institution. By means of simple diagrams, the peculiarities of English grammar are explained; a mouth map shows how each of the 33 sounds of English are pronounced. A 1,000-word vocabulary of "High Frequency English," spelled in the ordinary way and neo-

phonetically, is provided. In itself the key is believed to contain all the elements archeologists of the future will need to translate and pronounce 1938 English, but to make doubly certain, the Time Capsule itself contains multilingual texts, a dictionary and a lexicon of slang and colloquial English.

The third problem, choosing the Capsule's contents, proved the most difficult. It is inconceivable that any selection short of a most voluminous burial could adequately represent all the enormous variety and vigor of our contemporary scene. In making our selection we consulted archeologists, historians, authorities in art and literature, editors and many others. Out of thousands of suggestions, we finally chose to include some thirty-five articles of common use, ranging from a slide rule to a woman's hat, each selected for what it might reveal about us in the archeological sense. About seventy-five samples of common materials are included, ranging from fabrics of various kinds, metals, alloys, plastics and synthetics to a lump of anthracite and a dozen kinds of common seeds.

These material items, however, are only supplementary to a voluminous essay about us and our times, reduced to microfilm. On three and a half small reels there are reproduced books, articles, magazines, newspapers, reports, circulars, catalogs, pictures; discussing in logical order where we live and work, our arts and entertainment, how information is disseminated among us, our general information, our religions and philosophies, our education and educational systems, our sciences and techniques, our earth, its features and peoples; medicine, public health, dentistry and pharmacy, our major industries and other subjects. This "Micro-file" comprises more than 22,000 pages of text and 1,000 pictures; a total of more than 10,000,000 words. It includes instructions for making, among other things, a motion picture projection machine. For use with this are three spools of newsreel, made up especially by RKO-Pathe Pictures, Inc., showing about twenty characteristic significant or historical scenes of our times, complete with sound. A magnifier is, of course, included for reading the microfilm. Instructions are provided for making a full-size reading machine.

This task of leaving word of our time for "futurians" has been undertaken with a deep sense of our responsibility. It could never have been done were it not for the willing help of many men of science, hundreds of whom have made valuable suggestions, or given time and thought to the details of the venture. Space does not permit naming many of them here, but I can not forbear mention of Dr. Clark Wissler, of the American Museum of Natural History, whose guidance throughout has been most valuable.

Further details of the Time Capsule project will be reported fully elsewhere. Complete lists of the contents and other information will be sent to any one interested. It is hoped that this pioneer effort will encourage others to deposit even more adequate records of our day in many places, and at such intervals as will provide "futurians" with a complete running history of their past, our present.

DAVID S. YOUNGHOLM,
Vice-President, Westinghouse Electric and Manufacturing Company

THE SALARIES OF MEN OF SCIENCE EMPLOYED IN INDUSTRY

IN connection with an investigation of the pecuniary rewards of great abilities, I have obtained the facts for the starred men in the Cattell list of 1935 who were employed by business concerns.

There were seventy-two such men. Twenty-seven of them were employed by companies not listed in the Treasury report to the Ways and Means Committee. Of the others, twenty-nine presumably received less than $15,000 per year, inasmuch as their salaries are not reported. But a few may have been on leave of absence or not included by some error. This leaves sixteen receiving $15,000 or over as shown below, with the persons' reported fields of research:

$15,000 to $19,999	4	(chemistry, optics, physics, psychology)
20,000 to 24,999	2	(chemistry for both)
25,000 to 29,999	4	(chemistry for three; electrical engineering)
30,000 to 34,000	1	(chemistry)
35,000 to 39,999		
40,000 to 44,999	1	(chemical engineering)
45,000 to 49,999		
50,000 to 54,999	1	(photography)
55,000 to 59,999	1	(physics and electrical engineering)
60,000 to 64,999		
65,000 to 69,999	1	(chemistry)
70,000 to 74,999	1	(chemistry)

I estimate that ten of the twenty-nine men in these companies received $10,000 to $14,999 and nineteen of them $5,000 to $9,999.

Most of the men receiving over $15,000 have managerial responsibilities. But some of them are nearly or quite as free as they would be if employed by universities or philanthropic institutions. I think, however, that $21,500 is the highest of the salaries paid for work under such conditions. The man receiving it has managerial responsibilities, but perhaps no more unpleasant or distracting than those of the head of a university department or laboratory for pure research.

E. L. THORNDIKE

TEACHERS COLLEGE,
COLUMBIA UNIVERSITY

SCIENTIFIC BOOKS

THE TSETSE FLIES OF EAST AFRICA

The Tsetse Flies of East Africa. A First Study of their Ecology, with a view to their Control. By C. F. M. SWYNNERTON. With a preface by the Right Hon. W. Ormsby-Gore, M.P. Trans. Royal Entomological Society of London, Vol. 84, pp. xxxvi + 579, frontispiece, 22 pls., 7 folded maps, 33 figs. in text. November, 1936. £5-10-0.

THE recent tragic death of Mr. C. F. M. Swynnerton in an aeroplane accident recalls the fact that he had introduced aerial inspection and photography in his work as director of the Tsetse Research Department of Tanganyika Territory with a view to mapping the forest and plant associations. These ecological associations of the African vegetation play a major part in determining the location, abundance, breeding, feeding and pupation areas of the seven species of tsetse flies which infest this territory. The "fly" in turn plays a dominating role in the human culture here and elsewhere in tropical Africa from Senegal and the Sudan to southern Rhodesia.

In Tanganyika the eight species of tsetse fly, the several species of the blood-parasitizing trypanosomes of which they are in varying host-parasite relations, the insect vectors, men, cattle, the host of African game mammals, birds, crocodiles, snakes, and lizards in whose bloods the trypanosomes are variously multiplied and on whose bloods the fly selectively to some extent and often by reason of hunger feeds, the grasslands and varied bush, forest and jungle, the streams and lakes, and the changing season all combine in an ecological picture of great complexity and ceaseless changes. Man enters the picture as the victim of both the Rhodesian trypanosome and *Trypanosoma gambiense,* causes of the fatal African sleeping sickness. His domesticated animals also fall victims to other trypanosome infections, notably nagana, the fatal disease of cattle. His movements and those of his cattle attract the flies and spread these vectors and the disease-producing flagellates into new territories. He clears the forest, burns the grasslands and changes the habitats of the flies and the wild game whose bloods constitute an unfailing reservoir infected by trypanosomes or ready to be infected at birth or even before birth across the placenta from the infected mother. He abandons fly-infested regions, crowds his herds into narrower confines, and the resulting overgrazing leads to destruction of the plant cover. Soil erosion then permanently ruins the region. In recent years the fly has been steadily advancing into hitherto fly-free regions in Tanganyika with resulting havoc to the native people and their settlements and herds.

It was Swynnerton's task to discover means of practical control of vital factors in this complicated picture or of local parts of it which would save both the livelihood and the lives of these pastoral and agricultural tribes. It was not a swivel chair job for testing our naturalists' haphazard guesses but one of tragic necessity on the one hand and limited knowledge and resources on the other.

This condensed abbreviated report is rightly designated as an ecology. Its object has been to find weak links in the chain of relations between the hosts and the insect vectors of trypanosome infections. To this end the natural history of the eight species of tsetse fly in the region was thoroughly investigated as to the plant communities of its vegetational habitat, the feeding grounds, the rest-haunt and the breeding grounds and their respective furnitures. The environmental factors, altitudinal, geological, climatic, soil, humidity, temperature and vegetation were also analyzed and mapped or recorded. The geographical and local habitat distribution was worked out by quantitative and statistical methods based in part on systematic fly catching by trained native boys, trapping with a great variety of traps and baits, and records of sexes, weights in relation to hunger, feeding, age and breeding, and seasonal and other changes in the fly population. Since the female tsetse fly feeds with reference to reproduction and develops only a single egg at a time, depositing this in the pupa stage in damp surroundings, these statistical investigations have a direct bearing on many aspects of the problems studied. The complexity of the situation is increased by the fact that each species has its own distinct pattern of life not transferable by analogy or inference to another species.

The wild game animals play a large role in the tsetse drama. The flies follow moving animals; hence game forms not merely a reservoir of infections but active vehicles in transportation along forest trails and to and from waterholes in the dry season and across natural and artificial barriers. Experimental evidence shows that sight guides flies to their moving hosts and that a road to be safeguarded from flies from the adjacent bush must have at least 200 and preferably 500 yards on either side cleared of fly cover. Scent comes into action at shorter distances. Mammalian glands were effectively used in baiting traps. Scent seems to guide flies to favored species and sex of host or even to favored individuals. The author places little confidence in game extermination

fly control, as impracticable because of reinvasion, difficulties in accomplishment and unreliability in a partially settled country.

This report is itself a summary, and a review must be wholly inadequate in presenting the riches of experiment in laboratory and field, and the extraordinarily diverse aspects of the problems discovered and attacked. Certain practical results are enumerated and lines of endeavor in control tested and judged in the light of results. A few of the significant conclusions are as follows: Each species of fly and each biotic area must be studied in detail before control measures should be undertaken. In studying the problems each suggestion arising from observations in the field was examined as to its feasibility, practicability, difficulties, cost and effectiveness, tested in the laboratory and on a small scale in the field, and then on a control basis. As a results of such studies recommendations are made for cessation of annual burning of the bush by the cattle-grazing natives, the building up of fly barriers by native bush, preferably evergreen, which are traversed slowly if at all by the fly, clearness of infested fly territory by native settlement, control of plant associations and methodical trapping of flies of certain species in certain territories till they are so reduced in numbers that human occupation can continue. Roads through fly country can be made safe by clearing, and fly concentrations can be isolated in like manner. In general the author favors policies of control by knowledge of the ecological factors most accessible to economical change and most potent in each ecologic niche in reducing the mass of the tsetse menace below the level of human disaster. Extermination is out of the question. Even then the enormousness of the task for tropical Africa is appalling.

As an example of practical ecological investigation and resulting control measures this investigation is outstanding in its magnitude, scope and accomplishments. It is a far-sighted, wide-visioned and skilfully operated attack upon one of the most tragic, complex, intricate and perplexing problems in parasitic ecology facing human civilization in a great continent.

One encouraging feature is the tribute paid to native helpers for their industry, faithfulness and inventiveness in attacking these problems.

CHARLES A. KOFOID

TELEVISION

Electron Optics in Television. By I. G. MALOFF and D. W. EPSTEIN. McGraw-Hill Book Company.

WHEREAS it might seem that electron optics in television was a rather specialized subject, of interest to communication engineers rather than to physicists, the book is of somewhat broader scope than is indicated by its title.

In the first 40 pages of introduction, the authors give a good review of current cathode ray television technique, with particular emphasis on various scanning and viewing devices. They then develop the subject of electron optics. First they consider the emission of electrons from various sources. The treatment is clear, and this portion of the book might form a useful text for teaching. The next subject to be considered is the analogy between electron optics and light. There follows a detailed treatment of electron optics, covering the trajectories of electrons in fields of various geometries. Electrostatic lenses and the defects and aberrations which these show are discussed at some length, as well as the techniques used to overcome these errors.

Then, deflection of electrons in magnetic fields and various types of magnetostatic lenses and focussing are described. This discussion of electron optics is unusually complete, and will, no doubt, be of value to all physicists dealing with electronic or molecular beams, be they in mass spectrographs, cyclotrons or Van de Graaf generators.

The second portion of the book deals with the television cathode ray tube itself. First, the electron gun is described, and the deflection of the beam, the types of luminescent screens and various ratings and classes of tubes. Finally various accessories are explained, most of which are circuits for special purposes, such as relaxation oscillators, impulse generators, multivibrators and driving circuits. The final chapter will seem to many physicists to be a rather elementary discussion of vacuum technique. The second portion of the book is more specialized and perhaps not of as great interest to physicists generally as the first. Throughout, the figures are clear, and the book will make a useful addition to a physics library.

S. A. KORFF

BARTOL RESEARCH FOUNDATION OF THE FRANKLIN INSTITUTE, SWARTHMORE, PA.

REPORTS

THE RESEARCH COUNCIL ON PROBLEMS OF ALCOHOL[1]

THE American Association for the Advancement of Science, through its permanent secretary, Dr. F. R. Moulton, made on October 3 the first public announcement of a new approach to the liquor problem through the launching of an associated organization known as the Research Council on Problems of Alcohol, the present membership of which includes nearly 100 distinguished scientists and educators from various sections of the country, as well as a group of citizens prominent in public and industrial life. The plan of the council,

[1] Press release from the office of the permanent secretary of the American Association for the Advancement of Science.

it is stated, is to make a "thorough, unbiased and strictly scientific investigation of the problems related to the control of alcoholic beverages and to seek solutions through a program of unprejudiced research and education." Dr. Moulton stated that this program is regarded as ranking in importance with the symposia sponsored by the association on such problems of public health as cancer, tuberculosis, leprosy, syphilis and mental health.

Dr. Karl M. Bowman, director of psychiatry at Bellevue Hospital and professor of psychiatry in New York University, is chairman of the fifteen-man executive committee, of which ten are required to be scientists. Dr. Hans T. Clarke, professor of biochemistry, Columbia University, is chairman of the scientific committee, while Willard E. Givens, executive secretary of the National Education Association, has been elected chairman of the educational committee. Dr. Moulton is secretary. Other executive committee appointments are: Dr. Luther Gulick, professor of government, Columbia University, and director of the Institute of Public Administration; Austin H. MacCormick, commissioner of correction of the City of New York; Dr. Nolan D. C. Lewis, professor of psychiatry at Columbia University; Dr. Winfred Overholser, superintendent, Saint Elizabeth's Hospital in Washington, D. C.; Dr. A. T. Poffenberger, professor of psychology at Columbia, and Albert W. Whitney, consulting director, National Conservation Bureau.

Dr. Harry H. Moore, formerly director of the Committee on the Costs of Medical Care and public health sociologist in the United States Public Health Service, has been chosen as director of the council's activities, with headquarters in New York.

Dr. Moulton emphasized "the extreme care with which the membership of the council had been limited, during its twelve-month organization period, to outstanding scientists and educators who are acknowledged leaders in their various fields." Members of the executive committee of the American Association for the Advancement of Science are *ex-officio* members of the council, including the present president, Dr. Wesley C. Mitchell, professor of economics at Columbia University, well known as a social scientist. The closeness of the tie-up of the Research Council to the association is evidenced by the provision that all funds of the council shall be administered and disbursed by the association.

Details of a 21-page outline of the program were outlined by Dr. Bowman. They included a six-point premise, of which the highlights were as follows:

> Prohibition was not successful. A large army of law enforcement officers with funds totalling many millions of dollars was not able, from 1920 to 1933, to prohibit the sale and use of alcoholic beverages. Repeal has not been successful. Excesses and abuses are evident to all. Under both prohibition and repeal, alcoholic beverages, when used unwisely, have caused inefficiency, disease and death.
>
> At least two specific evils are recognized both by the "wets" and "drys." These are alcoholism and highway accidents due to the use of alcohol. In respect to many other aspects of the alcohol problem, there is a chaos of opinion. There is danger of hasty and unwarranted decisions in respect to the legal control of the liquor business.

The outline refers to the solution of the alcohol problem as one of the major perplexities of our civilization. It continues:

> On top of all the intrinsic difficulties of the situation, there have been superimposed emotional and political elements that have produced still further complications.
>
> It has become evident that nothing can be accomplished by the application of main force. If we are to find a way out, it can be only through the development of a complete factual basis on which can be built some effective plan of action. The main and primary objective of the Research Council on Problems of Alcohol is the development of such facts; the secondary objective is to make these facts available to the public in such a way that they will do the most good. Since the development of facts is essentially a scientific procedure, the personnel of the Council will be predominantly made up of persons who are working in the field of science. To these will be added such others from the fields of education, business and public life as will be able to assist in carrying out the secondary objective.
>
> What does science say about abstinence and prohibition? Here are two controversial questions which make the task of any agency dealing with them an extremely difficult one. In such a situation society is fortunate if it can turn to the scientist. The scientific attack on the problem of alcohol here outlined does not imply a commitment on the part of the scientist, or of any one else, to either the present "wet" or "dry" position. The scientist believes that if an adequate body of factual data is made available and discussed fully, without heat or prejudice by men and women of intelligence, integrity and leadership, the right solution of these two questions may then be evolved. Whether truth, as revealed by science, points the way to abstinence for the individual and prohibition for society, or to moderation for the individual and to some other form of control for society, or to a modification or combination of one or more of these policies, it will be the right solution for the time and place in which we live.

Briefly summed up, the Research Council defines its field of action in the following platform:

> The Council will conduct research, arrive at conclusions based on research, present the facts in suitable form to interested groups, and encourage intelligent discussion of the facts.
>
> The Council will not arrive at conclusions based on assumptions or prejudiced opinion, engage in propa-

ganda, lobby for liquor control laws, or participate in political campaigns.

Enlarging on the above definition, the program continues:

In attacking the problem of alcohol, there are three stages—research, education and control. While present conditions are unsatisfactory to all interests, and while many persons would like to "do something" about the problem at once, science says that to proceed without a sufficient body of factual material might lead to grave mistakes.

A well-organized body of facts is needed in regard to (a) the effects of alcohol on the individual, (b) the effects of alcohol on society and (c) the effectiveness of various measures of industrial and legal control which have been attempted or which may be proposed. When the facts have been ascertained, through research, two kinds of remedial measures may then be developed—educational measures and measures of control.

Education as to the effects of alcoholic beverages on the individual and on society is approved by both wets and drys. It must be carried on among both young people and adults. With the enactment of prohibition, in most communities education about alcohol practically stopped. Propaganda—both wet and dry—took the place of education. Now education must be strictly scientific; instruction must be given without prejudice, emotion or moralizing. Law enactment and law enforcement agencies need scientific knowledge regarding all aspects of the problem. Such knowledge obviously is essential to the development of effective governmental controls.

As to measures of control, when the biological facts about alcoholic beverages are ascertained and disseminated among the people, they will then be in a better position, as individuals, to exercise self-control. When all the facts, biological and sociological, are placed before the various agencies responsible for the social control of the liquor business, society may then be more justified than it has been in the past in expecting them to develop effective industrial and legal controls.

That the results of data secured to date by previous scientific research will not be overlooked and wasted is assured by the following provision:

The Council's policy provides for the integration of the results of all studies. In outlining its program of research, the Council will take into account other adequate studies in the field which have already been conducted, which may be contemplated and which may be under way; and it will assign each of its own studies, so far as is practicable, to other research agencies, such as universities, hospitals and professional organizations. Finally, it will constantly seek to integrate the results of all studies for the purpose of resolving contradictions, of filling gaps in existing knowledge, and of making available a reasonably complete and well-organized body of factual data in a form which will assure its usefulness.

Whether the findings of the various studies are favorable or unfavorable to the use of alcoholic beverages, they will be published without prejudice.

Members of the Scientific Committee, in addition to Dr. Clarke, are:

Philip Bard, professor of physiology, the Johns Hopkins University; Walter B. Cannon, professor of physiology, Harvard University; Alan M. Chesney, dean, School of Medicine, the Johns Hopkins University; Edwin G. Conklin, professor of biology, Princeton University; Thomas R. Crowder, director, Department of Sanitation and Surgery, Pullman Company; Frederick P. Gay, professor of bacteriology, Columbia University; Frank B. Jewett, president, Bell Telephone Laboratories; Norman Joliffe, Bellevue Hospital, New York; E. K. Marshall, Jr., professor of pharmacology, the Johns Hopkins University; George B. Pegram, professor of physics, Columbia University; Charles R. Stockard, professor of anatomy, Cornell University; Edward A. Strecker, professor of psychiatry, University of Pennsylvania; Warren T. Vaughan, physician, Richmond, Virginia; C. H. Watson, medical director, American Telephone and Telegraph Company; Willis R. Whitney, vice-president in charge of research, General Electric Company.

Additional members of the Council are:

Anton J. Carlson, professor of physiology, University of Chicago; Ray Lyman Wilbur, president of Stanford University; J. McKeen Cattell, editor, The Science Press; Walter M. Dickie, director of public health, State of California; Charles H. Durfee, psychotherapist, Wakefield, Rhode Island; Vincent du Vigneaud, professor of biochemistry, Cornell University Medical College; Foster Kennedy, professor of neurology, Cornell University; Eugene Opie, professor of pathology, Cornell University; Harlow Shapley, professor of astronomy, Harvard University; Wilson G. Smillie, professor of public health, Cornell University; M. H. Soule, professor of bacteriology, University of Michigan; John Sundwall, president, American Association of School Physicians; H. E. Himwich, professor of physiology, Albany Medical College; Arthur H. Compton, professor of physics, University of Chicago; Otto P. Geier, chief medical officer, Cincinnati Milling Co.; Clarence M. Hincks, general director, National Committee for Mental Hygiene; Esmond R. Long, director, Henry Phipps Institute; R. A. Millikan, chairman, Executive Council, California Institute of Technology; Stuart Mudd, professor of bacteriology, University of Pennsylvania; Bernard Sachs, neurologist, New York; W. A. Sawyer, medical director, Eastman Kodak Company; Loyal A. Shoudy, chief medical officer, Bethlehem Steel Company; C. V. Weller, professor of pathology, University of Michigan; Reginald M. Atwater, executive secretary, American Public Health Association; George Howard Gehrmann, medical director, E. I. du Pont de Nemours Co.; McIver Woody, physician, Standard Oil Company of New Jersey; John L. Rice, commissioner of health, City of New York; Adolf Meyer, psychiatrist-in-chief, the Johns Hopkins Hospital; Howard Funk, principal, Junior High School, Bronxville, N. Y.; Fred J. Kelly, chief, Division of Higher Education, U. S. Office of Education; Daniel Prescott, professor of education, Rutgers University; Homer P. Rainey, director, American Youth Commission of the American Council on Edu-

cation; Thomas D. Wood, chairman, Joint Committee on Health Problems in Education, National Education Association and American Medical Association; Willard W. Beatty, director of education, U. S. Office of Indian Affairs, recently president, Progressive Education Association; Frank P. Graham, president, University of North Carolina; R. A. Kent, president, University of Louisville; Roy G. Ross, general secretary, International Council of Religious Education; Donald J. Cowling, president, Carleton College; F. L. Bishop, Highway Education Board; John Q. Rhodes, president, Association of Motor Vehicle Administrators; Roger William Riis, public relations counsel; W. Roy Breg, executive secretary, Allied Youth; Thomas H. MacDonald, chief, United States Bureau of Public Roads; Russel E. Singer, general manager, American Automobile Association; Samuel Thorne, attorney; Thomas D. Thacher, attorney; Percy Jackson, attorney; Harold B. Hoskins, vice-president, Cannon Mills, Inc.; Edward W. Freeman, vice-president, Suchar Process Company; Edwin C. Jameson, president, Hamilton Fire Insurance Co.; Graham Edgar, vice-president, Ethyl Gas Corporation.

SPECIAL ARTICLES

INFLUENCE OF ADRENALECTOMY ON ANTERIOR PITUITARY KETOGENESIS IN RATS

In 1934 Long and Lukens[1] first described experiments revealing that adrenalectomy produces a marked reduction in the ketone body excretion of the depancreatized cat. Since then a number of investigators have reported that adrenalectomy similarly affects the ketonuria consequent to phlorhizin intoxication,[2] pregnancy,[3] fasting[3] and the administration of extracts of the anterior pituitary gland.[3,4] This reduction in ketonuria has been attributed to a decrease in ketone body formation consequent to the removal of the adrenal cortex. However, several other interpretations of the decrease in ketonuria are possible without having recourse to the hypothesis that the adrenal cortex, or its hormone, is essential for ketogenesis.

The observation made incidentally by MacKay and Barnes[3] that the adrenalectomized rat may develop a ketonemia after the administration of an extract of the anterior pituitary gland suggested to us that the adrenals may not be essential to the ketogenic activity of anterior pituitary extracts. For that reason, a series of studies was started to investigate more closely the blood and urinary ketone body content of normal and adrenalectomized animals treated with a crude extract of the anterior pituitary gland.

Rats were adrenalectomized forty-eight hours before the administration of a crude extract of beef anterior pituitary glands (A.P.E.), and were given normal saline "ad lib" during the interval. No attempt was made to maintain these animals for periods longer than forty-eight hours before administering A.P.E., since we did not desire the secondary effects of an adrenal insufficiency to interfere with effects attributable to the absence of the glands *per se*. All animals, normal and adrenalectomized, were fasted for seventeen hours before the injection of A.P.E. subcutaneously and of saline intraperitoneally. Following the injections, the urine was collected for eight hours and its ketone body content determined by the method of Van Slyke and Fitz. At the end of the eight-hour period, the animals were bled from the aorta and the blood ketone body content was determined by the same method.

Our data, summarized in Table I, indicate that in the absence of the adrenal glands, A.P.E. administration is relatively ineffective in producing a ketonuria; an observation which is in accord with that of others. However, the blood ketone body content indicates no apparent disturbance in the ability of adrenalectomized rats to manufacture these substances. In fact, if anything, the blood ketone content of the adrenalectomized rats is greater than that of the normal animals. That of the adrenalectomized rats is 5.7 mgm per cent. higher than that of the normal group, the ratio of the difference of the means to the standard error of this difference being 2.53.

TABLE I

Experimental group	No. of rats	Average weight gms.	Fasted hours	Blood ketones* 8 hours after A.P.E. mgm per cent.	Urine ketones* 8 hours after A.P.E. mgm per 100 gm
Normal	20	191	17	18.2	5.9
Adrenalectomized .	17	163	17	23.9	0.9

* Expressed as acetone.

One possible explanation of these data is that presented by MacKay and Barnes,[5] who postulated that adrenalectomy results in an increased ketolysis, which in turn is responsible for the decrease in ketonuria. However, the fact that the blood ketone content is at least as great in our adrenalectomized animals as it is in the normal group makes it obvious that irrespective of whether ketolysis is or is not increased, the same

[1] C. N. H. Long and F. D. W. Lukens, SCIENCE, 79: 569, 1934.

[2] G. Evans, *Am. Jour. Physiol.*, 114: 297, 1936.

[3] E. M. MacKay and R. H. Barnes, *Am. Jour. Physiol.*, 118: 184, 1937.

[4] E. G. Fry, *Endocrinology*, 21: 283, 1937.

[5] E. M. MacKay and R. H. Barnes, *Am. Jour. Physiol.*, 122: 101, 1938.

degree of ketonuria should occur in both instances. Since a decreased ketonuria occurs in adrenalectomized animals and since ketogenesis apparently is undisturbed, ketolysis can not be regarded as the factor responsible for the decreased ketonuria.

A more plausible explanation for the discrepancy between the ketone body excretion and the blood ketone level is that following the removal of the adrenal glands, the renal threshold for ketone bodies is markedly increased. Thus, even with identical blood ketone levels the adrenalectomized animal will excrete less ketone bodies than will the normal. This is in accord with the observations of many investigators who have demonstrated that adrenal insufficiency is characterized by marked abnormalities in renal function,[6] and hence it is not surprising that these renal disturbances manifest themselves by an inability of the kidney to maintain its normally low threshold for ketone bodies.

Our data suggest the conclusion that the adrenal gland *per se* is not essential for the ketogenic activity of extracts of the anterior pituitary gland and that an increase in the renal threshold for ketone bodies is responsible for the decreased ketonuria observed in the adrenalectomized animals treated with A.P.E. However, this does not exclude the possibility that in late stages of adrenal insufficiency secondary changes in liver function ensue, with a consequent decrease in ketogenesis. These and other studies will be published in greater detail elsewhere.

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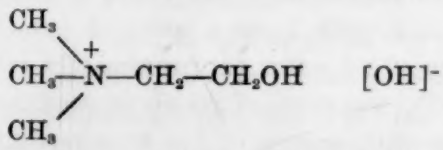
THE CHEMICAL NATURE AND NOMENCLATURE OF CHOLINE DERIVATIVES

CONSIDERABLE confusion exists as regards the nomenclature and understanding of the chemical nature of compounds of the choline type. Choline is an organic homologue of ammonium hydroxide, but the name suggests an amine. Perhaps because of this inappropriate



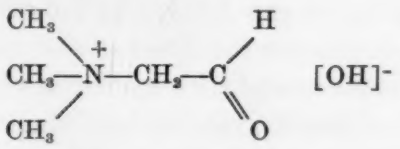
name it is not generally appreciated that choline, like tetramethylammonium hydroxide, is a very strong base, comparable with the caustic alkalies. Like sodium hydroxide, choline reacts with hydrochloric acid to form a chloride, a term which should be used in preference to "hydrochloride." Like sodium chloride, in aqueous solution the chloride salt of choline is neutral in reaction and dissociates into cations and anions. Strictly speaking, choline salts should no more be termed "choline" than should sodium chloride be referred to as "sodium," or ammonium chloride as "ammonium." The term "choline hydrochloride" is incompatible with the structure of this "onium" compound and the use of such terminology (by research workers and manufacturers) contributes to the erroneous idea that the chloride salt contains loosely bound hydrochloric acid which should be neutralized before biological use. It is obvious that these comments apply equally forcibly to the various derivatives of choline such as acetylcholine, "mecholyl," etc.

Ordinary nitrogenous compounds containing tri-(co)valent nitrogen form "salts" with hydrochloric acid by the addition of the hydrogen ion through a covalent link (shared electron doublet), making the molecule a cation and enabling it to hold the chloride ion by electrovalency. Such "salts" are termed hydrochlorides, although the nomenclature appears to have no justification except that of common usage, for "salts" with other than simple halogen acids are not so designated, for example, codeine phosphate, strychnine nitrate, etc.

In compounds of the choline type the four-covalent-one-electro-valent state is constant, an anion being ever present, whether it be hydroxide, chloride or bicarbonate. Substances of this type are classified as onium compounds and the names of the salts are derived in the same manner as are those of sodium hydroxide; for example, choline chloride, trimethyl-β-hydroxyethylarsonium bromide, tetramethylphosphonium sulfate, etc.

The importance of the charged nitrogen atom is evidenced not only by derivatives of choline, but also by such biologically significant compounds as vitamin B_1 and the nicotinic acid amide portion of the coenzyme system.

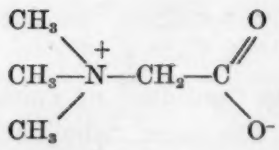
The nomenclature of the biological oxidation products of choline is unfortunate. Betaine aldehyde, the primary product of oxidation, has a particularly undesirable name, since it implies that the compound pos-



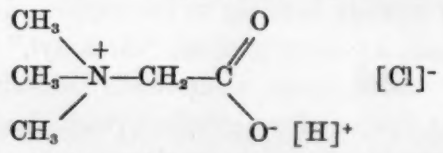
sesses the properties of a betaine, which is not the case. In aqueous solution betaine aldehyde and its salts are electrolytes, dissociating into cations and anions.

The name "betaine" (pronounced *bē′ tȧ in*) is generically applied to a large group of compounds having a zwitterion structure similar to that of the compound termed betaine specifically, the latter being the secondary oxidation product of choline.

[6] A. Grollman, "The Adrenals," pp. 170 and 180. Williams and Wilkins Company, Baltimore, 1936.



In the case of betaine the hydrochloric acid salt is usually referred to as betaine hydrochloride, and with a great deal more justification than in the case of the chloride salt of choline or of the so-called hydrochlorides of alkaloids, etc. Inspection of the zwitterionic nature of the hydrochloric acid salt of betaine



indicates that the hydrochloric acid is loosely bound; in fact the hydrochloric acid may be titrated as free acid. Pure crystalline betaine hydrochloride may well be used as a stable source of standard hydrochloric acid; doubtless other stable, crystalline salts of betaine might be used as standards for other acids.

The present confusing nomenclature might be avoided by the use of the cumbersome, but adequately descriptive, chemical names, or by the introduction of a more logical system of common names, preferably based on the familiar term "choline" as the root. Since the names which have been proposed so far fail to indicate the onium structure of the compounds, Professor Austin M. Patterson has suggested (in a personal communication) the name *cholinium* for the choline cation; this would permit the use of the terms cholinium hydroxide, cholinium chloride, acetylcholinium bromide, etc., for the salts and derivatives. In such a system betaine aldehyde might become aldocholinium hydroxide, a name which indicates its properties, and betaine aldehyde chloride, aldo-cholinium chloride, a term which suggests its chemical and physiological relationships. The root name *cholonium* would appear theoretically more sound, but might be accepted less readily, since the relation to the term now in common usage is less easily recognized. A satisfactory name for betaine itself is not easily found, its carboxy group being difficult to indicate (carboxycholinium, according to the international system, would indicate the replacement of a hydrogen of the choline cation by a carboxyl group); betainium is the only root name which would appear applicable, and this is far from satisfactory.

The writer will welcome suggestions and comments on this or other systems of nomenclature for the choline compounds. Professor Patterson has suggested that if the workers in this field should arrive at definite proposals regarding terminology, these proposals might be presented to the American committee on biochemical and organic nomenclature of the International Union.

The author wishes to express his appreciation for the advice and suggestions of Professor Austin M. Patterson, Professor C. F. Cori, Profesor H. T. Graham and Dr. T. H. Jukes.

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BIOLOGICAL DETERMINATION OF VITAMIN B_1 (THIAMIN) IN RHIZOBIUM TRIFOLII

WHILE studying growth factor requirements of the nodule bacteria, it became desirable to determine the ability of the organisms to synthesize vitamin B_1. Since only minute amounts of cellular material were conveniently available, feeding experiments were impractical. The situation required a rapid biological assay, applicable to small quantities of ordinary culture media.

For this purpose, a quantitative method was developed, which is an application of Knight's[1, 2] demonstration that, under suitable conditions, the growth of *Staphylococcus aureus* is proportional to the amount of vitamin B_1 present in the medium. The base medium employed for the estimation of vitamin B_1 is similar to that of Knight[1, 2] and Fildes,[3] but with the substitution of casein hydrolysate for gelatine hydrolysate or known amino acids:

Acid hydrolyzed casein	20 ml (equivalent to 0.4 gm Merck's casein)
Dipotassium phosphate	0.5 gm
Glucose	0.3 gm
Cysteine, HCl	2.0 mgm
Nicotinic acid	0.02 mgm
pH–7.0	
Distilled water to 50 ml	

Five ml amounts of this medium are tubed, and sufficient distilled water added so that together with the addition of the test material, the final volume is 10 ml. The medium is autoclaved one hour at 15 pounds, vitamin B_1 additions being made under aseptic conditions after sterilization.

A trace of growth from a nutrient agar culture is suspended in 10 ml water (approximately 100,000 bacteria per ml), one drop of which is used for inoculation. No growth occurs in the base medium. However, as shown in Fig. 1, in the presence of as little as .00005 micrograms per ml of vitamin B_1, detectable growth results, the amount of growth increasing rapidly with higher concentrations of the vitamin to .001 micrograms per ml. Growth is determined after

[1] B. C. J. G. Knight, *Brit. Jour. Expt. Path.*, 16: 315–326, 1935.
[2] B. C. J. G. Knight, *Biochem. Jour.*, 31: 731–737, 1937.
[3] P. Fildes, G. M. Richardson, B. C. J. G. Knight and C. P. Gladstone, *Brit. Jour. Expt. Path.*, 17: 481–484, 1936.

incubation for 36 hours at 37° C. by turbidity measurements using the Evelyn electrophotometer.

One gram of pork liver, found by animal assay to contain 36 micrograms of vitamin B_1 per gram, was extracted four times for periods of five minutes each with boiling N/10 hydrochloric acid. This extract was adjusted to pH 7.0 with sterile sodium hydroxide and made up to 100 ml. The actual amount of vitamin B_1 present in dilutions of pork liver extract was calculated by comparing the resultant stimulation with that of known quantities of vitamin B_1 (see Fig. 1). The ordinates represent per cent. increase in light absorption due to turbidity, upon addition of the amounts of stimulant indicated on the abscissae. Those points falling on the steep part of the curve were selected for calculations. By obtaining several points in this region, a convenient check for a given determination is provided. An average from four separate determinations, none of which varied over 3 per cent. from the mean, was 32 micrograms vitamin B_1 per gram. Similar confirmations of the accuracy of the method when applied to biological materials were obtained with standardized samples of pork kidney and ham.

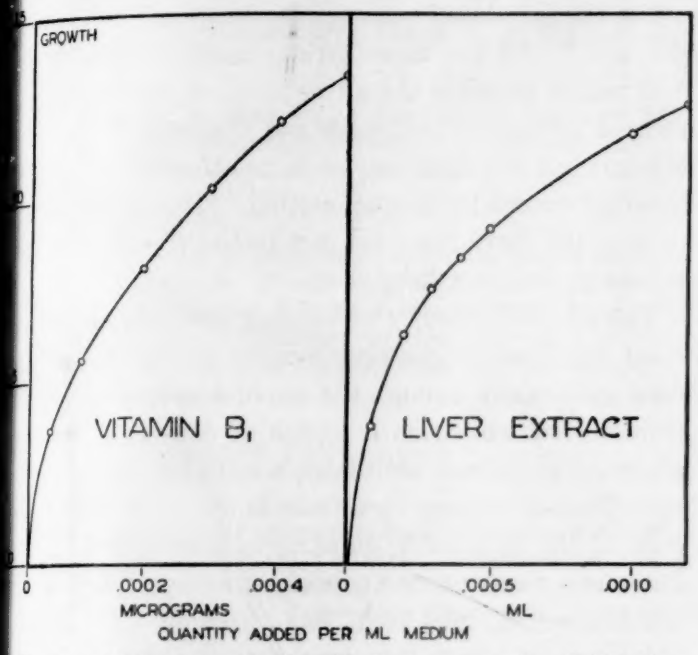

FIG. 1. Influence of vitamin B_1 on growth of *Staphylococcus aureus*. On left, the standard curve for pure vitamin B_1. On right, curve for liver extract to be assayed for vitamin B_1.

Six weeks' old cultures of *R. trifolii*, grown on a vitamin B_1-free synthetic medium were heated 15 minutes at 100° C. with N/10 HCl. This sufficed to liberate the free vitamin from combined form in which it apparently exists in the autolyzed cultures. Various cultures assayed averaged 19.6 micrograms of vitamin B_1 per gram of dry cells. This figure was in agreement with analyses by Meikeljohn's modification of Schopfer's test[4] which, however, is much less sensitive to vitamin B_1 and requires ten days for completion. From the data obtained, it appears that the vitamin B_1 content of *Rhizobium trifolii* cells closely approximates the amount known to be present in yeasts.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

APPARATUS TO ASSIST IN PHOTOGRAPHING EXPERIMENTAL MATERIAL[1]

THE apparatus described herewith has proved to be a very convenient device for photographing laboratory specimens, especially small animals such as rats. The advantages of this apparatus lie in the fact that photographs are taken in the laboratory under uniform conditions of distance and light and at about one-tenth the usual cost when made by a commercial photographer, for the individual photographs, and less than one half the usual cost for the pictures finally selected and enlarged for printing. In addition to a saving of time, the animals are not exposed to abnormal conditions outside the laboratory.

The apparatus consists of a boxlike arrangement with an opening at one end for inserting a camera and a hinged door at the opposite end for inserting the specimens to be photographed. A lamp recess is located on each side of the box. The insides of the lamp recesses are painted with white enamel. The inside of the box in which the camera is placed is painted black. A removable glass partition, made of clear window glass 9″ by 18″, with a wing 4″ wide cemented 1″ from each end is used to retain rats within 4″ of the hinged back door. The hinged door carries a gray cardboard, which serves as a background. Gray is desirable as a background for most objects, but since the cardboard is attached with thumbtacks, other colors may be readily substituted as a suitable contrasting background for the particular specimen to be photographed. A yellow cardboard makes a desirable floor when rats are being photographed. A 15-centimeter rule for showing comparative sizes, and a white card with sufficient data to identify the specimen, the date and the number of the particular photograph are attached to the door. These become an integral part of the photograph, but, if placed on the upper part of the door, may be blotted

[1] Published with the approval of the director of the New Mexico Agricultural Experiment Station.

[4] A. P. Meikeljohn, *Biochem. Jour.*, 31: 1441–1451, 1937.

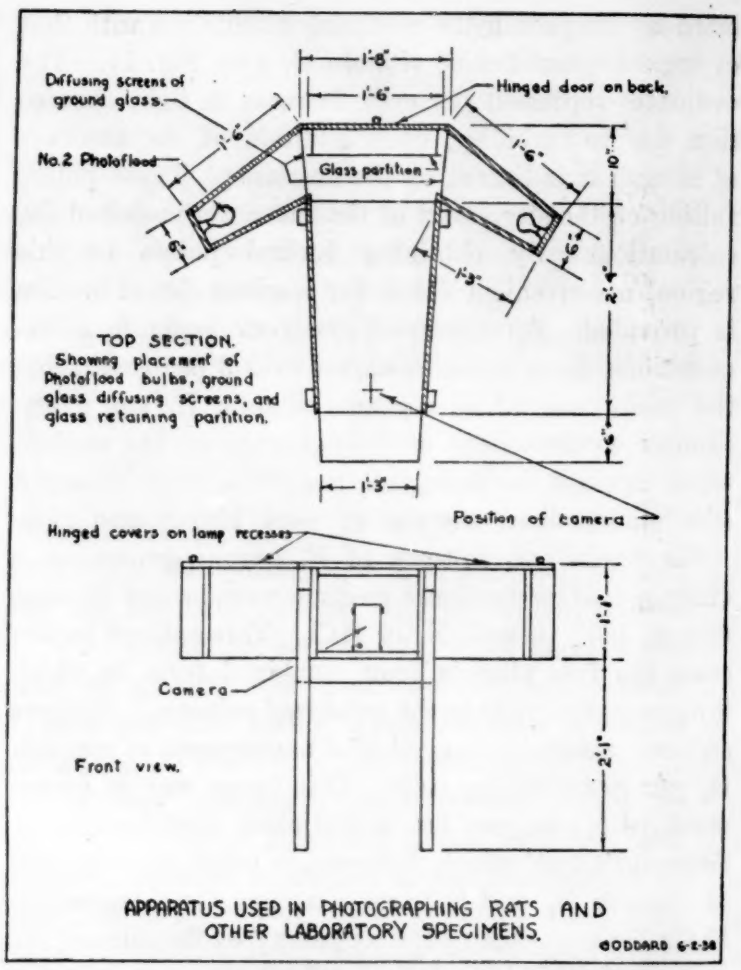

FIG. 1. Apparatus designed at the New Mexico Agricultural Experiment Station to assist in photographing rats and other laboratory specimens. The camera lens is placed 30 inches from the hinged door. The removable glass partition is 9″ × 18″ with four-inch wings cemented one inch from each end.

from the picture later if desired. A switch and plug-in light cord are attached to one side of the hinged back door. The dimensions given in Fig. 1 are for an apparatus to accommodate an Eastman kodak number 620, with a portrait attachment. Using supersensitive film, excellent photographs are secured with the lens of the kodak set 30 inches from the back wall, and with the kodak set for 1/25 second, an opening of 16, and the distance set as close as possible, slightly less than 5 feet. The objects photographed in this manner are approximately 14 per cent. of natural size, and when enlarged 3½ times, are ½ natural size. A photograph of a full-grown rat would thus be accommodated in the average journal page that is about 4⅓ inches wide. The dimensions given may readily be adapted to other cameras.

L. H. ADDINGTON

PHOTOELECTRIC "COLORIMETERS"

MESSRS. HARE AND PHIPPS, in SCIENCE, 88: 153, 1938, refer to certain alleged difficulties with the use of a single photocell in a photoelectric colorimeter, citing them as reasons for the development of another two-cell instrument. Inasmuch as such statements—though made, perhaps, because of insufficient information about a rapidly developing art—may create prejudice, it seems fair to present a correct statement regarding one of the instruments to which reference is made.

The authors state that the use of a single cell "requires a constant light source, the constancy of which is maintained by variable resistances in the lamp circuit, by a trickle charger on to a storage battery, or by a diaphragm placed between the lamp and the absorption cell." Of the three arrangements mentioned, the first makes possible the adjustment of current from a storage battery, whether or not the latter is kept on charge; but the light source is not thereby maintained constant except by manual setting. Obviously the purpose of the diaphragm can not be to maintain the light source at constant brightness.

The alleged difficulty of keeping the light source constant has been completely obviated in the Sheard-Sanford instrument through the use of a specially designed transformer which, on a source of constant frequency alternating current, maintains a constant power output regardless of voltage variations in the input. The purpose of the adjustable diaphragm is entirely different. It enables the operator to make precise adjustment of the amount of total light flux reaching the photocell, but does not affect the constancy of the light source. Neither are measurements with the Sheard-Sanford "Photelometer" affected by error "from the variations in the current produced by the cell caused by fatigue and changing temperature."

The Sheard-Sanford "Photelometer" is covered by U. S. Patents Nos. 2,051,317 and 2,051,320, the specifications in which disclose completely the principles employed in obtaining accurate measurements with a single photocell. All royalties from the sale of "Photelometers" have been assigned by Drs. Sheard and Sanford to the American Society of Clinical Pathologists.

P. E. KLOPSTEG

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